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Introduction

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

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Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S Government Printing Office at $8.50 for the three-volume set.

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3987**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **3992**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **3996**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **4001**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **4004**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **4017**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **4025**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **4030**

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **4034**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **4039**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **4042**

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Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **4052**

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Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **4060**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **4066**

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Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **4070**

17 MATERIALS, METALLIC
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18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **4080**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **4086**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **4091**

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Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **4097**

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Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **4164**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **4174**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **4178**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **4184**

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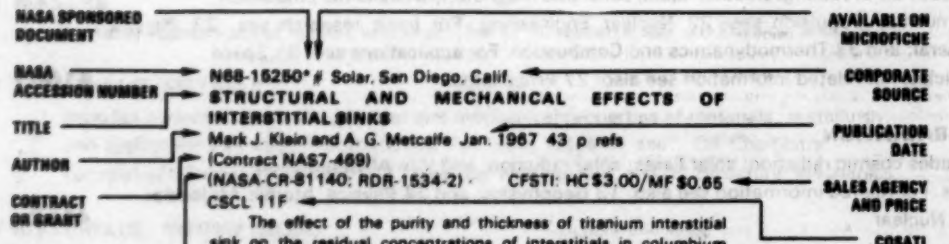

N68-15250* # Solar, San Diego, Calif.

STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS

Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs

(Contract NAS7-469)

(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65

CSCL 11F

The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-36038*# Wyle Labs., Inc., Huntsville, Ala.
EXPERIMENTAL STUDY OF SHOCK-PANEL COUPLING: PRELIMINARY RESULTS
J. A. Cockburn Mar. 1968 21 p refs
(Contract NAS8-21100)
(NASA-CR-61986; TM-68-3) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation to determine the significance of shock-panel coupling is described. A flexible panel subjected to supersonic turbulent flow was mechanically driven by an impedance head with and without a shock formed at the panel 1/2 chord position. The experimental results show that the presence of the shock causes a large increase in the modal stiffness, or impedance, of the panel which is not fully accounted for by the contribution from the static pressure behind the shock. A simple analysis, based on propagation of disturbances through the shock by panel motion, suggests that for low order modes shock-panel coupling can either amplify or resist panel motion, depending on the free stream Mach number, panel dimensions, vibratory mode and resonant frequency. However, it is not sufficiently clear whether the observed increase in modal stiffness is due to coupling or to increased damping caused by the separated flow. To clarify this point, and to investigate further the shock-panel coupling mechanism, additional experimental work covering a wide range of modal frequencies and flow Mach numbers is recommended. Author

N68-36081*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A FIVE JET VTOL CONFIGURATION IN THE TRANSITION SPEED RANGE
Richard J. Margason and Garl L. Gentry, Jr. Washington Oct. 1968 189 p refs
(NASA-TN-D-4812) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A wind tunnel investigation was conducted of a powered model of a VTOL fighter airplane configuration, having three lift engines in the forward fuselage and two deflected lift cruise engines in the aft fuselage, to determine the aerodynamic characteristics of the model in the transition speed range. The jet induced interference showed that the expected increase in lift loss and nose up pitching moment with increasing forward speed was rather small because of the counteracting effects of the front and rear jets. A substantial part of the nose up interference pitching moment was found to be due to the engine inlet mass flow for this engine arrangement. These results showed that increasing angle of attack had very little effect on interference lift and drag but that significant increases in interference pitching moment can occur if the horizontal tail is on or below the wing chord plane. Further investigation of tail height showed that the jet induced downwash was highest for the low tail position but that the jet induced longitudinal instability was mild for the three tail positions used in the tests. The effects of ground proximity were found to be relatively small for this configuration. Author

N68-36112*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF LARGE SIDESLIP ANGLES ON STABILITY CHARACTERISTICS OF A T-TAIL TRANSPORT CONFIGURATION
Edward J. Ray Washington Oct. 1968 48 p refs
(NASA-TM-X-1665) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation has been made to determine the effects of large sideslip angles on the static stability characteristics of a typical T-tail transport configuration. In addition, damping-in-roll derivatives were determined for the basic T-tail arrangement over an angle-of-attack range extending from about 0° to 36°. The effects of large sideslip variations on the pitching-moment characteristics were also ascertained for selected configurations. The study was made in the Langley high-speed 7- by 10-foot tunnel at a Mach number of 0.30 and a corresponding Reynolds number of 1.20×10^6. In order to assess this assumed linearity and to determine the lateral-directional characteristics over large sideslip ranges, several of the configurations were positioned at fixed angles of attack (range of 0° to 11°) and varied through sideslip angles extending from −22° to 22°. These tests indicated significant nonlinearities in the variation of yawing-moment coefficient with sideslip angle at relatively low angles of attack. Two aft nacelle locations were investigated and it was determined from this limited study that the static directional stability characteristics could be substantially influenced at moderate angles of attack and sideslip by the position of the nacelles on the rearward portion of the fuselage. Author

N68-36132*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A COLLAPSIBLE PLUG NOZZLE HAVING EITHER TWO-POSITION CYLINDRICAL OR VARIABLE ANGLE FLOATING SHROUDS AT MACH NUMBERS FROM 0 TO 2.0

Robert A. Wasko and Douglas E. Harrington Washington Oct. 1968 44 p refs
(NASA-TM-X-1657) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An experimental study was made concerning the effects of two types of shroud geometry on the performance of a collapsible plug nozzle. Shroud geometries considered were a two position cylindrical shroud and a variable angle floating shroud. Quiescent performance was obtained at nozzle pressure ratios from 2 to 15, and external flow effects were obtained at Mach numbers from 0.56 to 1.97. At subsonic cruise, the performance of the two position shroud was nearly comparable to that of the floating shroud. However, the two position shroud had better performance for subsonic acceleration whereas the floating shroud had better performance at supersonic Mach numbers. Maximum external flow effects occurred at Mach 1.2 for both shroud configurations. Author

N68-36133*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF MODEL FOREBODY SHAPE ON PERFORATED TUNNEL WALL INTERFERENCE
Glen A. Mitchell Washington Oct. 1968 47 p refs
(NASA-TM-X-1656) CFSTI: HC$3.00/MF$0.65 CSCL 01A

A 0.73-percent blockage cylindrical body was tested in the 8- by 6-foot supersonic wind tunnel with several forebody shapes to determine the magnitude of wall interference effects on model pressure distributions. The test section Mach number was varied from 0.4 to 2.0, and the distribution of wall porosity was adjusted. The forebody shape variations included cones with half angles of 15° and 42°, and a tangent ogive with a length to diameter ratio of 3. Results were compared to data on a 10° conical forebody from a previous test. Author

N68-36134*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BLOCKAGE EFFECTS OF CONE-CYLINDER BODIES ON PERFORATED WIND TUNNEL WALL INTERFERENCE
Glenn A. Mitchell Washington Oct. 1968 63 p refs
(NASA-TM-X-1655) CFSTI: HC$3.00/MF$0.65 CSCL 01A

A variety of cone–cylinder models were tested in the 8- by 6-foot supersonic wind tunnel at speeds from Mach 0.5 to 2.0 to evaluate the effect of wall reflected disturbances on model pressure distribution. In all cases, a 10° half-angle conical forebody was used; and the cylinder diameter was varied from 4 inches (10.16 cm) to 16 inches (40.64 cm). There were additional variations in model position within the test section and also in tunnel wall porosity. Author

N68-36193*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF BODIES OF REVOLUTION AT MACH NUMBERS FROM 1.50 to 2.86 AND ANGLES OF ATTACK TO 180°
Lloyd S. Jernell Washington Oct. 1968 40 p *ref*
(NASA-TM-X-1658) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation has been conducted in the Langley Unitary Plan wind tunnel to determine the aerodynamic characteristics of a series of cylinder, cone-cylinder, and ogive-cylinder bodies with various nose and afterbody fineness ratios for angles of attack from 0° to 180° and Mach numbers from 1.50 to 2.86. The data indicated that with the center of gravity located at 50 percent of the body length, none of the test configurations were statically stable at angles of attack near 0° or 180°. The magnitude of the normal force was primarily dependent upon the magnitude of the planform area. Generally, the more rearward the planform-area centroid, the more rearward the center of pressure. Author

N68-36322*# Scripta Technica, Inc., Washington, D. C.
VARIATIONAL PROBLEM OF THE SHAPE OF A MINIMUM-DRAG BODY WITH A GIVEN VOLUME AND GIVEN AREA OF THE SIDE SURFACE [VARIATSIONNAYA ZADACHA O FORME TELA MINIMAL'NOGO SOPROTIVLENIYA PRI ZADANNYKH OB'EME I PLOSHCHADI BOKOVOY POVERKHNOSTI]
G. I. Bogomolov NASA Sep. 1968 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekham. Zhidkosti i Gaza (USSR), no. 1, Jan.–Feb. 1968 p 106–110
(Contract NASw-1694)
(NASA-TT-F-11833) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Determination of the shape of a body of elliptical cross section exhibiting minimum drag at hypersonic velocities and zero angle of attack in the case of a given volume and area of the side surface. The problem involves the determination of the longitudinal generatrix when the transverse cross section of the body is given. The variational problem for the conditional extremum is solved with the precondition that the pressure, acting on the body in a hypersonic gas flow, is treated within the framework of the Newtonian theory. Author

N68-36334*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A HOVERING INVESTIGATION OF AN EXTREMELY FLEXIBLE LIFTING ROTOR
Matthew M. Winston Washington Oct. 1968 54 p refs
(NASA-TN-D-4820) CFSTI: HC$3.00/MF$0.65 CSCL 01A

A hovering investigation of an extremely flexible rotor was conducted to determine the effects of rotor-tip configuration and operating conditions on performance and to obtain a comparison with a conventional rotor. The results show the manner in which luffing (fabric instability) restricted the envelope of tip speed and collective pitch angles within which the rotor could be operated. In the range where the rotor could be operated, variations in tip speed altered the blade camber and resulted in substantial variations with tip speed in hovering performance, particularly at the higher thrust conditions. The results suggest the existence of optimum combinations of tip body mass, tip center of gravity, and tip stabilizer incidence for each value of tip speed since these variables determine the amount and distribution of blade camber and twist. The hovering efficiency of this rotor was poor in comparison with a conventional rotor. Because of the large amount of aerodynamically induced camber, however, the rotor attained very high mean lift coefficients. Author

N68-36433# ARA, Inc., West Covina, Calif.
RESEARCH ON HYPERSONIC FLOW OF BLUNT DELTA WINGS. PART 3: GAP EFFECTS OF A BLUNT SLAB DELTA WINGS AT MODERATE SUPERSONIC AND HYPERSONIC SPEEDS Final Report, Nov. 1966–Jan. 1968
Bernard Mazelsky and Chia-Chun Chao Feb. 1968 79 p refs
(Contract F44620-C-0038)
(ARA-93 Pt. 3; AFOSR-68-1037; AD-673849)

An experimental investigation of the effect of air ejecting from the windward side to the leeward side through gaps located on a delta wing on the aerodynamic performance was made at hypersonic speeds, M = 6 and 10, and at three Reynolds numbers, Re/ft = 1,500,000, 1,600,000 and 3,800,000. The tested data and the oil flow photographs indicate that the gap effect has a negligible influence on the lift and drag of the wing at the tested Mach numbers and Reynolds numbers. The model used in these tests was the same as that used for the previous experiment (Part II) wherein the gap width varied from 0.015 inch to 0.045 inch. In addition to the measurement of lift and drag, velocity profiles, surface pressures and base pressures were also measured in the present experiment. Author (TAB)

N68-36446# ARA, Inc., West Covina, Calif.
RESEARCH ON HYPERSONIC FLOW OF BLUNT DELTA WINGS. PART 1: THEORETICAL AND EXPERIMENTAL STUDY OF A 70° BLUNT DELTA WING FOR LOW ANGLES OF ATTACK AT SUPERSONIC AND HYPERSONIC SPEEDS Final Report, Nov. 1966–Nov. 1967
Bernard Mazelsky, Chia-Chun Chao, and Mei-Kao Liu Nov. 1967 82 p refs
(Contract F44620-67-C-0038)
(ARA-89, Pt. 1; AFOSR-68-1035; AD-673895)

The object of the present analysis is to investigate the high-speed aerodynamic properties of a blunt delta wing at low angles of attack where the maximum lift to drag ratio occurs. Oguchis solution of hypersonic flow over a blunt leading edge flat plate at zero incidence is extended to three dimensional delta wings at angle of attack. The shock wave shapes and pressure distributions were obtained by employing the oblique shock relations at the windward sides of the Prandtl-Meyer equations at the leeward side of the wing. The total lift and drag of the wing due to pressure and skin friction were computed by numerical integration using the IBM 7094 computer. The present calculated aerodynamic forces generally agree with the experimental data at the high supersonic Mach numbers (M approx. > or = 4) and lower thickness ratio of the wing which is a 70-degree swept slab sided delta wing with a cylindrical leading edge. Author (TAB)

N68-36469# Cincinnati Univ., Ohio Dept. of Aerospace Engineering.
ANALYTICAL PROCEDURE AND COMPUTER PROGRAM FOR DETERMINING THE DESIGN AND OFF-DESIGN PERFORMANCE OF FREE-VORTEX AXIAL-FLOW TURBINES INCLUDING EFFECTS OF TURBINE COOLING AIR
E. E. Flagg and W. Tabakoff Apr. 1968 210 p refs
(DAE-682; PB-178747) CFSTI: HC $3.00/MF $0.65

The analysis is a quasi-one-dimensional mean line procedure applicable to turbines having up to eight stages, allowing for a change in mean section radius interstage as well as between stages, temperature dilutation and radial pumping work due to cooling air injection schedule, as well as a subroutine link to incorporate gas properties as a function of temperature. Design type options include iteration to either hub reaction , rotor hub relative exist angle, or rotor exit mean line absolute swirl angle. Off design type options include geometry input as passage area or vector flow angle. The analysis is applicable from near zero speed to high speed, and the work done may be negative to the maximum work condition limited by discharge annulus area choking. Author (USGRDR)

N68-36508 National Aerospace Lab., Tokyo (Japan).
HIGH SPEED TESTS OF COMPRESSOR CASCADES WITH DOUBLE CIRCULAR ARC BLADE SECTIONS
Hiroshi Kondo, Mitsuhiro Minoda, Norio Yamazaki, and Noboru Furukawa 1968 14 p refs In JAPANESE; ENGLISH summary
(NAL-TR-152) CFSTI: $3.00

Two dimensional high speed cascade tests were made of thin double circular arc blade shapes under operating conditions, many of which were typical of compressor mean blade sections. Tests were made with porous walls and were repeated with solid walls; during the solid wall tests, schlieren photographs were made. When losses were low, turning angles did not change significantly below entering Mach numbers of 0.9. The low speed design angle of attack fell within the low loss region for Mach numbers below 0.8 in the lowest case and below 0.8 in the highest case. At higher Mach numbers, the minimum loss was obtained at higher angles of attack. The angle of attack range for minimum loss was found to be very small at high Mach numbers. Results have also shown the importance of the effect of inlet Mach number on the minimum loss incidence at stagger angles below 20°. Author

N68-36509*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF NOSE SHAPE AND FIN GEOMETRY ON STATIC STABILITY OF A HIGH-FINENESS-RATIO SOUNDING ROCKET
Dennis E. Fuller Washington Oct. 1968 29 p refs
(NASA-TM-X-1661) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Tests were conducted in the Langley 4- by 4-foot supersonic pressure tunnel to determine the effects of variations in nose shape and fin geometry on the static stability of two sounding rocket models having length-diameter ratios of 18.20 and 23.77. Tests were made at a Mach number of 2.01 for angles of attack from about −4° to 24° and for angles of sideslip from about −5° to 9°. The Reynolds number was 9.8 × 10^6 per meter. The results indicated that significant changes in nose shape and fin geometry had little effect in improving the pitching-moment nonlinearities of the high-fineness-ratio rockets. The fins of higher aspect ratio tended to improve the directional stability and to delay the induced rolling moments to higher angles of attack. Author

N68-36608# ARA, Inc., West Covina, Calif.
RESEARCH ON HYPERSONIC FLOW OF BLUNT DELTA WINGS. PART 2: GAP EFFECTS OF A BLUNT SLAB DELTA WING AT MODERATE SUPERSONIC AND HYPERSONIC SPEEDS Final Report, Nov. 1966–Jan. 1968
Bernard Mazelsky and Chia-Chun Chao Feb. 1968 86 p refs
(Contract F44620-67-C-0038)
(ARA-92, Pt. 2; AFOSR-68-1036; AD-673896)

It was found that the maximum lift to drag ratio of a flat delta wing at moderate supersonic and hypersonic speeds can be increased appreciably by letting a small amount of air pass through narrow gaps located at proper places on the wing. The increase in (L/D)max obtained from such a wing experiment varies from 5% to 17% at different speeds. Six gap configurations were tested at four different free stream Mach numbers, M = 4, 4.5, 5 and 8. Reynolds number was kept constant at Re/in = 300,000 and 700,000. Both the lift and drag of the wing were reduced due to the presence of gaps. Since the decrease in drag is greater than that of lift, L/D is thus increased. The reduction in lift is due to the loss of momentum and the increase of pressure in the induced separation region on the leeward side of the wing; the reduction in drag is due to the decrease in skin-friction caused by gap effects. Author (TAB)

N68-36784# TRW Systems Group, Washington, D. C.
AERODYNAMIC ANALYSIS OF VEHICLES IN TUBES
15 Apr. 1968 35 p refs
(Contract C-353-66(NEG))
(TRW-06818-6026-R000; PB-178796) CFSTI: HC $3.00/MF $0.65

The aerodynamic characteristics of a vehicle traveling in a tube are an important consideration in the analysis of high speed ground transportation systems. This report presents a list of the important aerodynamic parameters; an analysis of the various flow assumptions available to the researcher; a breakdown of the problem into two regimes, near field and far field; and a detailed description of the numerical analysis of the one-dimensional unsteady flow problem. Author (USGRDR)

N68-36982 Aerodynamische Versuchsanstalt, Gottingen (West Germany).
NONLINEAR BEHAVIOR OF THE AERODYNAMIC LIFT OF SLENDER, FLAT DELTA WINGS IN SUPERSONIC FLOW [ZUM NICHTLINEAREN VERHALTEN DES AUFTRIEBES SCHLANKER, EBENER DELTAFLEUGEL IN UEBERSCHALLSTROEMUNG]
W. Stahl 1968 56 p refs In GERMAN
CFSTI: $3.00

The characteristic non-linear behavior of lifting slender delta wings with sharp leading edges was studied experimentally and theoretically during supersonic speeds and at angles of inclination up to $\approx 10°$. It was found that non-linear lift disturbances caused by leading edge eddies described with increasing Mach number and almost disappeared at inclination angles from 4° to 10°. Transl. by G.G.

N68-37054*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT ON BASE DRAG OF RECESSING THE BASES OF CONICAL AFTERBODIES AT SUBSONIC AND TRANSONIC SPEEDS

William B. Compton, III Washington Oct. 1968 50 p refs

(NASA-TN-D-4821) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was conducted to determine the effect on base drag of recessing the bases of truncated conical afterbodies. The drag of a flat base was compared with the drag of recessed bases of equal size for afterbodies having boattail angles of 0°, 3°, 5°, and 10° and having ratios of boattail length to maximum diameter of 1.0 and 1.5. For each boattail, the amount of base concavity was varied in several steps from a flat base to an open base. A fully conical afterbody with a boattail angle of 10° was tested also. The tests were run at an angle of attack of 0° and through a Mach number range of 0.3 to 1.3. The Reynolds number based on model length was in the range of 8×10^6 to 16×10^6 depending on the Mach number. In addition, boundary layer profiles and afterbody drag coefficient plots are included. Results indicate that recessing the base gives an increase in base pressure coefficient of 0.01 to 0.03, depending on the boattail, and hence a reduction in base drag. For a given boattail, base drag decreases with increasing base concavity up to a certain point, but, beyond this point, further concaving the base has little or no effect. The ratio of the amount of base concavity to base radius necessary to achieve maximum base drag reduction depends on the boattail angle and length. Author

N68-37065*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF FLEXIBILITY ON LIFT AND PITCHING-MOMENT CHARACTERISTICS OF A SERIES OF LOW-ASPECT-RATIO WING-BODY COMBINATIONS AT TRANSONIC SPEEDS

Robert V. Doggett, Jr. and A. Gerald Rainey Washington Oct. 1968 49 p refs

(NASA-TN-D-4655) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Measurements of lift and pitching moment were made on a series of low aspect ratio wing–body combinations of different stiffnesses in the Mach number range from 0.70 to 1.10 and at angles of attack up to 30°. The configurations consisted of three different delta wings in combination with a single conical-cylindrical body. The three delta wings differed in leading-edge-sweep angle, aspect ratio, and area. Both rigid and flexible models were tested at Reynolds numbers per meter of 10.5×10^6 and 5.9×10^6. The experimental results indicated that there is no appreciable effect of vehicle flexibility on the lift characteristics for the models tested. The pitching moment characteristics were affected by flexibility; in general, increasing flexibility produced an appreciable deterioration of the static longitudinal stability characteristics. The linear theory showed good agreement with the experimental results in values of the lift curve slope at the zero lift condition. One of the nonlinear theories showed fair agreement with the experimentally determined lift characteristics for all three configurations. None of the analytical methods used were completely adequate for the prediction of the lift and pitching moment characteristics throughout the entire angle of attack range of the investigation. Author

N68-37151# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

ON THE EXPERIMENTAL TESTING OF THEORIES CONCERNING NON-STATIONARY THREE-DIMENSIONAL AIRFOILS IN INCOMPRESSIBLE FLOW [ZUR EXPERIMENTELLEN PRUEFUNG INSTATIONAERER DREIDIMENSIONALER TRAGFLAECHENTHEORIEN BEI INKOMPRESSIBLER STROMUNG]

Horst Hertrich 1967 115 p refs In GERMAN *Its* Mitt. aus dem Max-Planck-Inst. für Strömungsforsch. und der Aerodyn. Versuchsanstalt No. 40

CFSTI: HC $3.00/MF $0.65

Experimental pressure distribution measurements have been carried out on rigid airfoils with or without control surface subjected to harmonic oscillation using the 3m wind tunnel at the Aerodynamische Versuchsanstalt Göttingen. Measurements were performed on a rectangular half-wing and a sweptback half-wing with 0.6m constant chord. Both models were designed according to the NACA 0012 profile, the chord of the control surface being 30% of that of the wing. The aspect ratios were either $\Lambda = 3.1$ or 2.5. Non-stationary differential pressures were measured on seven cross-sections each with 20 measuring points. Investigations were carried out with oscillations directed along several axes perpendicular to the direction of the incoming flow and with pitch oscillations directed along the leading edge of the control surface. The results have been compared with those obtained on the basis of the three-dimensional, two-dimensional and infinite thin wing theories. Author (ESRO)

N68-37238*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLOW FIELD PROPERTIES NEAR AN ARROW WING-BODY MODEL AT MACH NUMBERS OF 1.60, 2.36, AND 2.96

Robert L. Weirich and Walter A. Vahl Washington Oct. 1968 136 p refs

(NASA-TN-D-4809) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A wind-tunnel investigation was conducted at supersonic Mach numbers to determine the flow-field properties near an arrow-wing-body model at several stations which were considered to be potential locations for engine air inlets. The tests were conducted at Mach numbers of 1.60, 2.36, and 2.96 at a Reynolds number of 9.84×10^6 based on a 1-meter length. The model angle-of-attack range was 0° to 9° and the model angles of sideslip were 0°, 5°, and −5°. The local flow parameters—Mach number, upwash and sidewash angles, and ratio of local to free-stream total pressure—were measured by pressure-instrumented 15° half-angle conical probes. These local flow characteristics are presented as contour plots for the locations which were surveyed. The results of this investigation indicate that several locations are potentially suitable as inlet locations. Below the wing-body, the Mach numbers are less than the free-stream value and the flow is reasonably uniform except in the region of the wing-body juncture. Locations below the fuselage and below the wing appear suitable for inlets. Above the plane of the wing, the Mach number is generally greater than the free-stream value. However, near the fuselage the flow is uniform except at high angles of attack, and this region appears suitable as an inlet location. Author

N68-37265*# Air Vehicle Corp., La Jolla, Calif.

NONLINEAR LIFT AND PRESSURE DISTRIBUTION OF SLENDER CONICAL BODIES WITH STRAKES AT LOW SPEEDS

E. S. Levinsky and M. H. Y. Wei Washington NASA Oct. 1968 64 p refs

(Contract NAS2-3523)

(NASA-CR-1202) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Nonlinear vortex lift and pressure distributions were obtained analytically for conical bodies of circular and elliptical cross-section

with small span sharp-edged conical wings or strakes of arbitrary dihedral angle. The analytical approach, which is an extension of the Mangler and Smith theory for slender flat triangular wings, made use of a generalized conformal transformation to map this class of wing-bodies of high volumetric efficiency into a vertical slit. A single pair of spiral vortex sheets was assumed to originate from the leading edge of each strake. The shape and strength of the spiral vortex sheet were determined as part of the calculation procedure. The nonlinear theory was evaluated by comparing with low-speed wind tunnel force and pressure data obtained on a series of related models. Both theory and experiment indicated relatively large increases in lift with even the smallest strake sizes considered, viz., 10% of the body radius. Good correlation between theory and experiment was obtained over the complete angle of attack range for cones with strakes of 50% of the body radius or greater. For these configurations, the lift was approximately twice the linear theory value at angles of attack equal to twice the strake semi-apex angle. Author

N68-37331# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
EQUATIONS, TABLES AND CHARTS FOR SHOCK DRAG PARAMETER (MACH NUMBER: 1.1-15.0, SHOCK ANGLE: 90°-MACH ANGLE)
Takashi Sawada and Sekiji Yamagata Aug. 1968 85 p refs
(ISAS-427, vol. 33, no. 9) CFSTI: HC$3.00/MF$0.65

An investigation is made on the determination of shock wave drag of a body in a supersonic free stream of an ideal gas from the shape of the shock wave given either by theory or experiment. Assumption is made that the flow condition changes isentropically along each streamline behind the shock and the pressure regains the free stream value far behind the body. The total wave drag is obtained in a form of an integral of shock drag parameter, ϕ, which is a function of free stream Mach number and local shock angle, over entire shock surface. Numerical values of ϕ are presented in tables and charts. Asymptotic solution of ϕ in the far field is also given. Author

N68-37365*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND TUNNEL INVESTIGATION OF THE LOW SPEED HIGH LIFT AERODYNAMICS OF A ONE-FIFTH SCALE VARIABLE SWEEP SUPERSONIC TRANSPORT
Anthony M. Cook Washington Oct. 1968 126 p refs
(NASA-TN-D-4844) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Low-speed aerodynamic characteristics of a large-scale variable-sweep supersonic transport model were determined in a 40 by 80-foot wind tunnel. Included are data for the model both in and out of ground effect. The results are presented as six-component aerodynamic force and moment data obtained at various angles of attack and sideslip. The investigation was made at a free-stream dynamic pressure of 25 pounds per square foot, corresponding to a Reynolds number of 11 million, based upon the mean aerodynamic chord of the fully swept wing. The majority of testing was directed toward the optimization of high-lift configurations and the investigation of longitudinal stability and control characteristics for the take-off and landing configurations. Data concerning low-speed flight at highter wing sweeps of 30°, 42°, and 72° are also presented. It is shown that the model maintained acceptable levels of longitudinal stability up to 13° angle of attack at high lift in both the landing and take-off configurations. The model also exhibited lateral and directional stability up to high angles of sideslip. Author

N68-37393*# Pratt and Whitney Aircraft, East Hartford, Conn.
EXPERIMENTAL EVALUATION OF TRANSONIC STATORS. DATA AND PERFORMANCE REPORT MULTIPLE-CIRCULAR-ARC STATOR A (SLOTTED)
M. J. Keenan and J. A. Bartok 1968 126 p refs
(Contract NAS3-7614)
(NASA CR-54624; PNA-3411) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A multiple circular-arc stator, slotted from the tip to 40% of span and from 60% of span to the bulb, was tested over a range of flow angles and velocities during a study of stator blade sections capable of operating at high-flow Mach numbers. Stator inlet flow was generated by an inlet guide vane and a flow-generating rotor; and transonic stator inlet flow was achieved at design speed, although Mach numbers were slightly lower than the design values. Analysis indicated that flow through the stator slot was at or near choke conditions at design speed and all higher speeds; and, at all speeds, the ratio of slot flow to compressor flow increased with increasing back pressure. Maximum airflow design speed was 134.3 lb/sec, 0.7 lb/sec less than design value; and overall efficiency at design speed and 134.3 lb/sec airflow was three points lower than predicted. Blade element and pressure coefficient data tabulations are included, along with numerous graphs that depict the results. M.W.R.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-36068# Department of Transportation, Washington, D. C. Office of Noise Abatement.
AIRCRAFT NOISE EVALUATION
William C. Sperry Sep. 1968 80 p refs
(FAA-68-34)

The Federal Aviation Administration, in response to Public Law 90-411, has begun the rulemaking process leading to the certification of aircraft for noise. The basic element in the regulation criteria is the noise evaluation measure designated as effective perceived noise level, EPNL, which is a single number evaluator of the subjective effects of aircraft noise on human beings. Simply stated, EPNL consists of instantaneous perceived noise level corrected for tones and duration. The history of the development of EPNL is presented and a critical evaluation of its validity is made. The computational procedures are described in detail including both integration and approximate methods for calculating duration corrections. Examples are given. Author

N68-36073*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LANDING LOADS AND ACCELERATIONS OF THE XB-70-1 AIRPLANE
Ronald J. Wilson and James M. McKay Washington Oct. 1968 29 p refs
(NASA-TN-D-4838) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Data are presented on landing contact conditions for the first 48 landings of the XB-70-1 airplane. Landing weights varied from 419,800 pounds to 274,600 pounds. Vertical velocities at touchdown ranged from 5.26 feet/second to 1.49 feet/second.

Maximum indicated airspeed was 195.0 knots, with a minimum of 167.3 knots. Landing contact conditions of the XB-70-1 are compared with those of a modern turbojet transport. The mean vertical velocity at touchdown for the XB-70-1 was 3.21 feet/second, which was 1.59 feet/second higher than that reported for the turbojet transport. A mean indicated airspeed of 180.5 knots was 47.7 knots greater than that reported for the transport. The maximum XB-70-1 roll angle (3.0) and rolling velocity (3.28 deg/sec) at touchdown were less than the values (4.3° and 8.7 deg/sec, respectively) for the transport. The measured main gear maximum vertical reaction generally compared favorably with predicted values. The nose gear initial maximum vertical reactions were generally less than the predicted values. The mean acceleration measured at the pilot's station was 1.39g due to main gear impact and 1.54g due to nose gear impact. Author

N68-36074*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARATIVE STUDY OF FUSELAGE TANKS FOR LIQUID METHANE FUELED SUPERSONIC AIRCRAFT
Rene E. Chambellan and William A. Bevevino Washington Oct. 1968 18 p refs
(NASA-TN-D-4837) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Three designs of flight-weight nonintegral tanks, capable of gage pressures of 15 or 30 psi (10.8 or 20.7 N/cm^2), were studied. Two void spaces representative of a forward and an aft fuselage segment were selected. Ratios of tank weight to contained fuel weight range from 0.0110 to 0.0482 and volumetric efficiencies range from 75 to 95.4 percent. Tanks studied are thin walled pressure vessels of titanium or nonmetallic fabric constrained to an envelope by structural elements internal to the tank. Author

N68-36268# Department of Transportation, Washington, D. C.
CONFERENCE ON FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS
[1967] 184 p refs Meeting held 11–12 Dec. 1967
(AD-672036)

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N68-36269# Department of Transportation, Washington, D. C.
NTSB SUMMARY OF TRANSPORT AIRCRAFT ACCIDENTS INVOLVING FIRE OR EXPLOSIONS IN THE FUEL SYSTEM
A. B. Hallman *In its* Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 5–8 (See N68-36268 23-02)

Bar graphs are presented to relate the aircraft fire problem to the total accident picture for transport aircrafts. Rotary wing aircraft and nontransport aircraft were not included, but accidents in which fuel tank vapor-air content was suspect were included. Of the 711 accidents that occurred between 1957 and 1966, 105 involved fatalities although 645 of the accidents were judged to be survivable on the basis of impact alone. Fire was involved in 143 accidents; with 105 having impact fires, 30 involved in fires during flight, and 8 with ground fires. There appears to be a trend with regard to a slightly higher proportion of impact fires for turbojet aircraft than for "recip" aircraft, with 22 of 116 turbojet accidents involving fires and 61 of 357 recips involved in fires. There was also the indication that the inflight fire problem of pod mounted turbojets is less severe than that of recip-powered aircraft. M.W.R.

N68-36270# Department of Transportation, Washington, D. C.
THE FAA PROPULSION R&D PROGRAM ON FUEL SYSTEM IGNITION HAZARDS
Thomas G. Horeff *In its* Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 19–34 refs (See N68-36268 23-02)

Various projects conducted in connection with the FAA long-range research and development program on fuel system ignition hazards are reviewed, including flame propagation and flame arrester tests as well as lightning strikes and resultant internal sparking. The three projects completed during the long-range program dealt with: (1) characteristics of triggered natural lightning, and airflow velocity effects on lightning ignition of fuel vent efflux, (2) turbine fuel flammability within fuel tanks under turbulent flight conditions, and (3) vent system flame propagation characteristics. Potential benefits from modified fuels are being studied in terms of development of thickened fuels for reduction of the fuel hazard following survivable crash landings. M.W.R.

N68-36271# Naval Research Lab., Washington, D. C. Chemistry Div.
GENERATION AND DISSIPATION OF ELECTROSTATIC DISCHARGES IN AIRCRAFT FUEL SYSTEMS
Joseph T. Leonard *In* Dept. of Transportation Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 35–64 (See N68-36268 23-02)

Fuel charging during flow in a pipe, discharges from a fuel surface inside a tank, and effect of filtration on fuel charging in an aircraft refueling system are among the topics discussed in a lecture and accompanying slides that deal with the generation and dissipation of electrostatic discharges in aircraft fuel systems. Conditions for ignition, flammability and temperature-flammability limits for common fuels, and the apparatus used to study discharges from fuel surfaces are considered. A comparison is made of the discharges from a fuel surface to grounded probes of various configurations with the discharges from a metal plate. Energy of discharges from a metal plate to a 1-in. sphere is compared with discharges from a fuel surface. Mention is made of the static dissipative additive as the most generally accepted solution to the problem of electrostatic discharges. M.W.R.

N68-36272# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Research and Technology Div.
AIR FORCE HISTORY AND EXPERIENCE WITH INERTING, SUPPRESSION, AND PURGING SYSTEMS

F. A. Wright *In* Dept. of Transportation Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 65–76 (See N68-36268 23-02)

Various types of inerting systems, including experiences with reticulated foam, are reviewed. Air Force experiences indicate foam to be most desirable because of ease of installation and lack of post-installation problems. At installations where foam is not considered desirable, the use of bottled nitrogen or an explosion suppression system are considered practical, depending upon the particular aircraft configuration involved. This historical overview of Air Force inerting, suppression, and purging systems was accompanied by a series of illustrations, which are not included in the present document. M.W.R.

N68-36273# Department of Transportation, Washington, D. C.
ALPA STATEMENTS ON NEED FOR FUEL TANK INERTING AND/OR FLAME SUPPRESSION ON NEW AND IN-SERVICE AIRCRAFT
Vic Hewes *In its* Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 77–94 (See N68-36268 23-02)

The need to acquire protective devices for fuel tank inerting and/or flame suppression on both new and inservice aircraft is discussed. Studies of engine disintegration have indicated that nacelles cannot be armor-plated to contain turbine bursts, or compressor disk disintegration. The fact that most flight operations are conducted on partially empty tanks is noted, and that landing approaches are generally made with about one-fifth tank capacity; and that such large empty spaces are filled with vapors that can easily ignite. While polyurethane foam in tank areas can prevent some fires and explosions, tests have shown that fires occurring after impact may be more severe because the foam spreads the fuel over greater areas. It is felt that costs rather than technology are hindering the development and installation of protective devices. M.W.R.

N68-36274# Department of Transportation, Washington, D. C.
AIR TRANSPORT ASSOCIATION PRESENTATION ON FIRE SAFETY MEASURES ON AIRCRAFT FUEL SYSTEMS
Allen W. Dallas *In its* Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 95–110 (See N68-36268 23-02)

The airlines point of view on fire safety measures for aircraft fuel systems is presented; and alternate fuels, special components and devices, and various venting and inerting suppression systems are discussed. Mention is made of emulsified and gelled fuels, diesel and heating oils, and other alternative propellants. Uses of antistatic additives, static discharge wicks and lines, lightning diverter rods, lightning resistant overwing filler caps, and flame arresters are mentioned. Attention is given to fuel surge tank vent system design, surge tank vent suppression, foam and other overall suppression systems, and liquid nitrogen and carbon dioxide inerting systems. Airline system requirements are discussed, along with operational modes and protection afforded by various protective systems and devices. Maintainability, reliability, and other aspects of such means of protection are considered. M.W.R.

N68-36275# McDonnell-Douglas Co., St. Louis, Mo.
EVOLUTION OF FUEL SYSTEM FIRE SAFETY IN THE AIRCRAFT INDUSTRY
Carl A. Weiss *In* Dept. of Transportation Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 111–114 (See N68-36268 28-02)

Evolution of fuel system fire safety in the aircraft industry is reviewed, with the notation that fuel has always been considered one of the most serious aviation hazards. Mention is made of some of the new problems, such as engine case burnthrough, that occurred with the advent of jet aircraft; and consideration is given to ground fires hazards. M.W.R.

N68-36276# Boeing Co., Seattle, Wash.
CURRENT DEVELOPMENTS OF FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS
B. A. Honsberger *In* Dept. of Transportation Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 115–142 (See N68-36268 23-02)

An extension of the aerospace industry viewpoint is presented in a speech on current developments and devices for prevention and containment of fires in aircraft fuel systems. Lightning diverter rods, protector vents and flame arresters, non-sparking components, flame suppression, modified fuels, foams, and inerting systems are discussed. Vent exit design research is mentioned, along with other current efforts to provide better protective devices against aircraft fuel fires. M.W.R.

N68-36277# Lockheed-California Co., Burbank.
FACTORS INFLUENCING THE APPLICATION OF NEW FIRE SAFETY
E. F. Versaw *In* Dept. of Transportation Conf. on Fire Safety Meas. for Aircraft Fuel Systems [1967] p 143–150 (See N68-36268 23-02)

Aircraft industry requirements for fuel fire protective devices are discussed, and factors influencing the application of fire safety measures are discussed. Safety is considered the foremost concern of the design engineer; and reliability, maintainability, and amenability to routing checkout are the next factors in order of importance to the designer. Simplicity in design is not considered mandatory, although it usually leads to a higher degree of reliability. Weight and cost factors are considered the most controversial, and the need to keep these at a minimum is considered to be vital to the aerospace industry as long as safety is not compromised. Continual updating of fire safety practices is stated as a goal of the aircraft industry. M.W.R.

N68-36289# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AN EXPERIMENTAL INVESTIGATION OF GROUND EFFECT ON A FOUR-PROPELLER TILT-WING V/STOL MODEL Final Technical Report
William F. Putman Jul. 1968 65 p refs
(Contract DA-44-177-AMC-8(T))
(Rept.-892; USAAVLABS-TR-68-45; AD-673824)

Tests were conducted on a one-tenth scale model of a tilt-wing V/STOL at specified points simulating flight conditions at various heights above the ground. The model was moved at selected velocities through still air; and lift, drag, and pitching moment were measured at various heights above the ground. Investigations included combinations of 30, 40, and 60 deg wing incidence angle with 30, 40, and 60 deg flap deflection, and thrust coefficients ranging from 0.80 to 0.95. Model ground clearances of 3.5 to 36 inches were investigated both at constant altitude and with the altitude continuously varying during the run. The data are presented as plots of lift, drag, and pitching moment coefficients. Also included are data from wind tunnel tests on similar models. A brief analysis is made of ground effect phenomena and an understanding of the general data trends is obtained. The magnitude and direction of the force change in ground effect are predictable. However, the pitching moment change is strongly influenced by factors such as the flow field beneath the fuselage, the change in downwash at the horizontal tail, the other effects. Author (TAB)

N68-36338# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
A TECHNIQUE FOR THE EVALUATION OF AIRCRAFT RIDE QUALITY Final Report, 1 Aug. 1967–1 Jan. 1968
John W. Rustenburg Jun. 1968 37 p refs
(ASD-TR-68-18; AD-673871)

Experience has shown that the aircraft gust sensitivity index A, defined as the root mean square (RMS) acceleration response per unit of RMS gust velocity does not provide a consistent measure of aircraft ride quality. Ride quality is also influenced by variation in the frequency spectrum of the vibration environment and time of exposure. A ride quality evaluation technique is presented which includes consideration of frequency effects on human discomfort, exposure time, and variation of the vibration environment during a mission. This technique can be used to evaluate ride quality of existing aircraft as well as to provide ride quality criteria for new aircraft designs. It can be applied to military as well as commercial aircraft. Author (TAB)

N68-36486# General Dynamics Corp., San Diego, Calif. Electric Boat Div.
ADDITIONAL SIMULATION STUDIES OF SEAPLANE RESPONSES IN REGULAR AND RANDOM WAVES
R. M. Hopkins Jan. 1968 132 p refs
(Contract Nonr-4978(00))
(U419-68-001; AD-673323)

A previous simulation of a seaplane-sea system in three degrees of freedom for takeoff and landing analysis (See AD-648 848) was reconstructed in several models at the new Convair hybrid computer complex. Considerable imporvement over previous results was obtained. The final hydrodynamic model is finally fitted with two airframes, and each model is then operated in random waves of two intensities. It is shown that the STOL model reduces takeoff distances and maximum vertical accelerations in sea state 4 (significant wave height of 6 feet) by more than 80 percent. Author (TAB)

N68-36504# National Aeronautical Establishment, Ottawa (Ontario).
A FLIGHT INVESTIGATION OF VARIOUS STABILITY AUGMENTATION SYSTEMS FOR A JET-LIFT V/STOL AIRCRAFT (HAWKER-SIDDELEY P1127) USING AN AIRBORNE SIMULATOR
D. M. McGregor Feb. 1968 42 p refs
(NRC-10257; LR-500) CFSTI: HC $3.00/MF $0.65

A variable-stability helicopter was used in the tests. Emphasis was placed on overcoming the directional divergence due to the unstable weathercock stability that occurs at low airspeeds, but short investigations of a roll stabilizer to reduce the pilot work load, and a pitch stabilizing device to assist the pilot to maintain attitude in the presence of an angle-of-attack instability, were included. Both visual and simulated instrument flights were conducted. After testing several stabilizing devices, it was concluded that a lateral accelerometer operating through the yaw reaction controls yielded directional handling qualities in the acceptable-satisfactory region. Author

N68-36505# Royal Aircraft Establishment, Farnborough (England).
EQUIPMENT FOR FLIGHT VIBRATION TESTS OF THE S.S.T. CONCORDE [APPAREILLAGE D'ESSAIS DE VIBRATION EN VOL DE L'AVION CONCORDE]
G. Piazzoli Jun. 1968 28 p refs Transl. into ENGLISH of ONERA-TN-120 Rept.
(RAE-LIB-TRANS-1309) CFSTI: HC $3.00/MF $0.65

Because of the structural flexibility of the airplane, of the severe environment in the flight domain, of the safety prerequisites, and of the necessary reliability, the solutions adapted are situated at the advanced level of today's technological possibilities. Nineteen seismic electrodynamic exciters belonging to four types will be located on the wind, on the tail, and inside the fuselage. Particular attention will be paid to the programming of the appropriation of the vibratory shapes and to the optimization of the time given to the testing sequences. Qualification tests of this equipment were carried out with a dynamic balance simulating the elastic parameters of the structure and the most critical environment. Measurements give results very nearly the same as those predicted. Author

N68-36513# Aeronautical Research Labs., Melbourne (Australia).
FLIGHT LOADS ON A CROPMASTER AGRICULTURAL AIRCRAFT
A. K. Patterson Oct. 1967 34 p refs
(AR/SM-320) CFSTI: HC $3.00/MF $0.65

Measurements have been made of the loads experienced by a Cropmaster agricultural aircraft while engaged in normal superphosphate spreading operations. The loads have been separated into those due to manoeuvres and to turbulence and the latter have been converted to equivalent gust velocities. Average load spectra of both types and average gust velocity spectra are presented. Histograms displaying the flight to flight variation of these spectra are presented. Gust velocity spectra and operating statistics are compared with those produced by measurements on other agricultural aircraft. The mean strain per "g" in the main spar of the wing has been estimated by a linear regression. Author

N68-36569# George Washington Univ., Alexandria, Va. Human Resources Research Office.
THE CAPTIVE HELICOPTER AS A TRAINING DEVICE: EXPERIMENTAL EVALUATION OF A CONCEPT
Paul W. Caro, Jr., Robert N. Isley, and Oran B. Jolley Jun. 1968 50 p refs
(Contract DA-44-188-ARO(D)-2)
(HUMRRO-TR-68-9; AD-673436)

The research objective was to determine the effectiveness of a new device concept for helicopter contact flight training and the usefulness of such a device for predicting performance during subsequent flight training. The device was a commercially available captive helicopter attached to a ground effects machine. Two experimental groups of trainees received 3 1/4 or 7 1/4 hours of device training prior to primary helicopter training. In comparison with control groups, both device trained groups (a) were significantly less likely to be eliminated from subsequent flight training for reasons of flying deficiency; (b) required less flight training to attain the proficiency required to solo the helicopter; and (c) received higher grades during early training. Trainees who performed well on the training device tended to perform well during subsequent flight training. Instructors using devices such as this one need not be proficient in the helicopter used for subsequent flight training. Author (TAB)

N68-36649# Federal Aviation Administration, Oklahoma City, Okla. National Flight Inspection Div.
COURSE REVERSAL FLIGHT SIMULATOR EVALUATION
Barney "B" Bryant Jan. 1968 20 p

Authorities requested an FAA simulator study of procedure turns to establish the distance required to complete the turn when it is begun at a specified point (fix). DC-6 and B-720 flight simulators were used in the evaluation. Several types of procedure turn were made at different altitudes. Adverse winds of near maximum expected velocities were applied. The evaluation shows that when a positive radio fix is used to mark the point to commence course reversal, a significant reduction in the required maneuvering area may be expected when a teardrop course reversal is flown in a procedure turn instead of the classic 45/180/45 or the 80/260 maneuvers. Author

N68-36652# Federal Aviation Administration, Washington, D. C. Flight Standards Service.
HELICOPTER ENROUTE IFR

Allan W. Hunting and Frank Parr Jan. 1968 36 p

An evaluation of Los Angeles Airways, Inc., pilots flying selected VOR routes was conducted under simulated IFR operation to assess the vertical and lateral flight technical error. Radar flight track tracings and movie film were used to collect data. A statistical analysis of the data shows that stabilized helicopters may be safely operated IFR within 25 1/2 miles of a VOR station when at least 500 feet of obstruction clearance is provided in the area of two nautical miles on each side of the radial providing course guidance with reduced obstruction clearance beyond 2 NM to a maximum lateral distance of 3 NM. Author

N68-36710# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ATMOSPHERIC TURBULENCE AFFECTING AIRCRAFT FLIGHT

N. Z. Pinus 5 Oct. 1967 199 p refs Transl. of the book "Atmosfernaya Turbulentnost', Vliyayushchaya Na Polet Samoletov" Moscow, 1962 p 1–167

(FTD-HT-67-185; AD-673809)

The book consists of two parts, devoted to problems of atmospheric turbulence affecting aircraft flight stability. Presentation of experimental data on aircraft bumpiness in the upper troposphere and in the tropopause layer in the articles is accompanied by discussion of theoretical problems relating to stability of air currents in the atmosphere, the effect of atmospheric turbulence on aircraft flight conditions, etc. The book is intended for specialists in meteorology and aerodynamics and persons involved in organizing and carrying out aircraft flights. Author (TAB)

N68-36913# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

ACOUSTIC ENVIRONMENTS OF THE F-111A AIRCRAFT DURING GROUND RUNUP

John N. Cole and Justus F. Rose, Jr. May 1968 60 p refs

(AMRL-TR-68-14; AD-673346)

Sound pressure level measurements were made on an F-111A aircraft at 250-foot radial distance with three different engine power configurations at Wright-Patterson AFB, Ohio. In addition, sound level measurements were made at four maintenance positions where personnel would typically be located during normal ground operations. These data were used to compute the power spectra, directivity indices, equal sound pressure level contours, equal perceived noise level contours, and equal speech interference level contours. These results are presented in graphical form and can be used to determine the acoustic environments at distances from 125 to 6000 feet from the aircraft during ground operation. Author (TAB)

N68-36925# Sandia Corp., Albuquerque, N. Mex.

NEAR FIELD NOISE OF AN F89 AIRCRAFT

D. O. Smallwood Nov. 1967 38 p refs

(Contract AT(29-1)-789)

(SC-DR-67-803) CFSTI: HC $3.00/MF $0.65

Data are presented on the near noise field (5 to 100 feet) of an F89 aircraft with two engines (J-35) at 100-percent power with afterburners. These data are presented as a contour plot of the overall levels plus narrow-band and third-octave plots for each microphone location. The maximum overall level observed was 152 db re 0.0002 μbar. Author (NSA)

N68-37018# Aeronautical Research Council (Gt. Brit.)

CIVIL AIRCRAFT AIRWORTHINESS DATA RECORDING PROGRAM STUDY OF SEVERE TURBULENCE ENCOUNTERED BY CIVIL AIRCRAFT

G. E. King London HMSO 1967 48 p refs Supersedes RAE-TR-67106; ARC-29535; see X68-11382

(ARC-CP-974; RAE-TR-67106; ARC-29535) CFSTI: HC $3.00/MF $0.65

Continuous trace records of airworthiness data have been taken from a small number of aircraft in normal airline service since October 1962. The acceleration trace on a sample of records covering 3284 flying hours has been read to give peak values. The durations of the patches of turbulence have been estimated and an attempt has been made to distinguish between gust and maneuver loads. The most severe of these patches of turbulence have been studied in detail; it is found that the largest acceleration in a patch is often larger than would be predicted from a Rayleigh distribution of peaks, which is the distribution normally used in spectral analysis of turbulence. Author (ESRO)

N68-37066*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF VARIATIONS IN NOSE AND WINDSHIELD GEOMETRY ON SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A VARIABLE-SWEEP TACTICAL FIGHTER MODEL

Celia S. Richardson Washington Oct. 1968 55 p refs

(NASA-TM-X-1664) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation was made in the low Mach number test section of the Langley Unitary Plan wind tunnel to determine the effects of various nose and windshield shapes on the aerodynamic characteristics of a current multimission tactical fighter model. Tests were performed for a wing leading edge sweep of 72.5° at Mach numbers of 1.6, 2.16, and 2.50, at angles of attack from about −2° to 20°, and at angles of sideslip of about 0° and 4°. The Reynolds number per foot was 3.0×10^6. The data indicate that each of the forebody modifications, which resulted in forebodies somewhat longer than the basic forebody, generally caused a slight increase in minimum drag and a reduction in directional stability. Author

N68-37075*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF REDUCED AIRSPEED FOR LANDING APPROACH ON FLYING QUALITIES OF A LARGE JET TRANSPORT EQUIPPED WITH POWERED LIFT

Harold L. Crane, Robert W. Sommer, and Frederick M. Healy Washington Oct. 1968 91 p refs

(NASA-TN-D-4804) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A flight research program was conducted to determine the effects of reduced landing approach speeds on the flying qualities of a typical large jet transport for simulated instrument approaches. The reduced approach speeds were made possible by a powered lift system which blew air over the upper surface of the wing flaps. The effects of reduced approach speeds on flying qualities and flying-qualities requirements are discussed. It was found that a 25 percent reduction in landing approach speed would not necessarily result in new requirements for satisfactory flying qualities. However, such items as pitch response and trim characteristics, Dutch roll damping, and lateral directional coupling are likely to be more difficult to maintain at satisfactory levels. Author

N68-37128# Aeronautical Research Council (Gt. Brit.)

A PILOTED FLIGHT SIMULATOR STUDY OF SPEED INSTABILITY DURING THE LANDING APPROACH

D. H. Perry London HMSO 1968 55 p refs Supersedes RAE-TR-66138; ARC-28363; see X67-11539

(ARC-CP-980; RAE-TR-66138; ARC-28363) CFSTI: HC $3.00/MF $0.65

The effects of speed stability and turbulence level on the handling of a small research aircraft were systematically studied by four pilots on a fixed base simulator. Pilot opinion ratings were compared with those obtained in flight trials of the real aircraft. Accuracy of speed and flight path holding was also determined on the simulator. Some discussion of such effects as inter-pilot variability, learning, the choice of performance measures, and the use of pilot opinion rating scales is included. ESRO

N68-37159# Department of Transportation, Washington, D. C. National Transportation Safety Board.
AIRCRAFT ACCIDENT REPORT. PAN AMERICAN WORLD AIRWAYS, INC., BOEING 727 N317PA NEAR BERLIN, GERMANY, NOVEMBER 15, 1966
1968 30 p
(PB-177339-7) CFSTI: HC$3.00/MF$0.65

The report covers the history of the flight from take-off to crash, and gives data in the mission, plane and personnel, along with the results of investigation following the crash. USGRDR

N68-37298*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
METEOROLOGICAL ASPECTS OF HIGH-ALTITUDE TURBULENCE ENCOUNTERED BY THE XB-70 AIRPLANE
L. J. Ehernberger [1968] 9 p refs Presented at the AIAA 3rd Natl. Conf. on Aerospace Meteorology, New Orleans, 6–9 May 1968
(NASA-TM-X-61114) CFSTI: HC$3.00/MF$0.65

A study of turbulence encountered by the XB-70 airplane was conducted and shows that turbulence of significant intensity at SST supersonic climb and cruise altitudes is related to wind velocity, vertical wind shear, and temperature parameters obtained from rawinsonde measurements. The data illustrates that high-altitude turbulence is found in several situations that are characterized by various combinations of meteorological parameters. Temperature transients encountered at altitudes near 60,000 feet in which the ambient temperature changes more than 5°C and the horizontal gradient along the flight path exceeded 1.5°C per 1000 feet (300 meters) were also illustrated. Author

N68-37343 Bolkow Entwicklungen K. G., Munich (West Germany).
COMPARISON OF COMPUTED RESULTS AND FLIGHT MEASUREMENTS ON A ROTOR WITHOUT JOINTS, BOLKOW SYSTEM [VERGLEICH VON RECHNUNGEN UND FLUGMESSUNGEN AN EINEM GELENKLOSEN ROTOR SYSTEM BOELKOW]
M. Rade 22 May 1968 40 p refs In GERMAN Presented at the DGLR Conf. on Rotary Wing Aircraft and Propellers, Stuttgart, 30 May 1968
(DF-74-0)

Results obtained during flight tests of the BO-105 helicopter are compared with calculated performance predictions. The rotor of this helicopter is completely rigid; it has neither a blade lag damper joint nor flapping hinges. The function of these joints is taken up by the elastic deformation of the glass-fiber-reinforced plastic rotor blade. Measurements and predictions cover controllability, longitudinal stability, blade bending moments, torque requirements, ground resonance, and blade bending oscillations. Transl. by K.W.

N68-37344 Bolkow Entwicklungen K.G., Munich (West Germany).
MEASURING INSTRUMENTATION AND IN-FLIGHT MEASUREMENTS ON THE HELICOPTER BO 105 [MESSINSTRUMENTIERUNG UND FLUGMESSUNGEN AM HUBSCHRAUBER BO 105]
Hans Gloeckl 10 May 1968 31 p In GERMAN Presented at the DGLR Conf. on Rotary Wing Aircraft and Propellers, Stuttgart, 30 May 1968
(DF-75-0)

The BO-105 is a multipurpose helicopter with rigid rotor, glass fiber-reinforced blades, and a two-turbine power plant. The following measurements were made during a total operating time of 100 hours: (1) strain gage measurements of stress and strain on fuselage and rotor; (2) moment measurements on rotor column, head, blades, and tail stabilizers; (3) strain gage measurements of control forces and servomechanisms; (4) fuselage vibration, particularly on pilot seat, main rotor gears, power plant, and tail rotor; (5) potentiometric determination of control input for pitch, lateral, longitudinal, and directional control, and pitch of rotor blade; (6) gyroscopic measurements of attitude stability, and rotational velocity; and (7) torquemeter measurements of performance of propulsion system and tail rotor. In addition, readings on the regular cockpit control panel were photographed. Wiring, telemetry, data recording, ground control, and the flight program are discussed. Transl. by K.W.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-36097*# Ion Physics Corp., Burlington, Mass.
SOLAR CELL COVER GLASS DEVELOPMENT Quarterly Technical Progress Report, 1 Oct. 1967–1 Apr. 1968
1 Apr. 1968 33 p
(Contract NAS5-10236)
(NASA-CR-97154; QTPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Summary data are given on continuing research to develop and optimize techniques for fabrication of thick integral coverslips for silicon solar cells which show a definite superiority over conventional glued coverslip cells. The automation of the high vacuum sputtering system is discussed and the results obtained with this system are given. Attention is focused on the testing and fabrication of SiO^2 coverslipped cells. The stress resulting from the high vacuum sputtering technique is studied along with the possibility of using a CeO^2 antireflecting coating between the silicon and SiO^2. An optical analysis technique is described for determining the light transmission characteristics and quality of SiO^2 films. Tabulated data are included on eight cells (four with integral cover slips of 2 mil thickness, and four with CeO^2 antireflection coating) subjected to ultraviolet vacuum testing. B.S.D.

N68-38241*# Ion Physics Corp., Burlington, Mass.
SOLAR CELL COVER GLASS DEVELOPMENT Quarterly Technical Progress Report, 1 May–1 Oct. 1967
1 Oct. 1967 62 p refs
(Contract NAS5-10236)
(NASA-CR-97123; QTPR-4) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The objective is refinement and economic optimization of techniques for fabrication of thick, integral coverslips for silicon solar cells. A basic assumption is that integral coverslip cells must show a definite superiority over conventional glued coverslip cells. This assumption provides natural guidelines for selection of

candidate coverslip materials, fabrication techniques, and environmental test end points. Specifically, all coverslip materials that are known to significantly degrade under ultraviolet, proton, or electron irradiation must be excluded from consideration. Similarly, all fabrication techniques that are deleterious to the cell structure itself must be rejected. Finally, the environmental and radiation test end points must be at least as severe as those encountered with glued coverslip cells. For ease in comparison, final testing is to be done on cells with 6 mil integral coverslips. Author

N68-36279*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
DEVELOPMENT OF MULTIPLE SOURCE—MULTIPLE LOW VOLTAGE CONVERTER–REGULATOR POWER SUPPLY WITH AUTOMATIC FAILURE SENSING AND REDUNDANT SWITCHING Final Report, 30 Jun. 1966–30 Jul. 1967
K. J. Jenson and J. V. McVay [1968] 82 p
(Contract NAS5-10148)
(NASA-CR-97128) CFSTI: HC $3.00/MF $0.65 CSCL 10B

With use of the practical, automatic, failure-sensing and redundant-switching circuitry developed during this program, it is now possible to fabricate reliable, efficient electrical power systems necessary for future, long-duration space missions. Reliability of the power system on long-time space missions can be significantly enhanced by incorporation of the developed circuitry in conjunction with the basic LIVCR. Additional benefits derived from the technology include: (1) increased flexibility facilitated by a basic modular design of respective LIVCR redundant subsections, (2) elimination of the need for telemetry monitoring and command switching, (3) increased system stability, and (4) decreased time elapse between failure occurrence and compensation. The program approach included four major tasks: (1) LIVC synchronization, (2) automatic failure sensing and compensation, (3) decreased unbalanced in single LIVC, and (4) redundant configuration considerations. Author

N68-36435# Naval Research Lab., Washington, D. C.
CHARACTERISTICS OF AN IMPROVED INERT-CATHODE/MAGNESIUM-ANODE SEA-WATER BATTERY
B. J. Wilson 11 Jun. 1968 24 p refs
(NRL-6715; AD-673399)

The inert-cathode/Mg-anode sea-water battery has demonstrated the capability to furnish power, generally in conjunction with a dc-dc converter, for a variety of marine underwater devices. A battery of this sort may be tailored to application and its performance predicted to within 10 to 20% of actual. Shelf life is long, upward from several years, on the basis of experience and materials. This shelf life presumes storage without the electrolyte and refrigeration. One exception exists in the case of the impulse cell where exposed storage periods in the order of 1 year lessens the magnitude and rate of cell response upon activation and the energy supplied over a given interval. Such loss may generally be compensated by initially allowing a greater margin of power. Operating life is adversely affected by accumulations of reaction products and varies with electrode spacing and current density. More than 60 days of continuous operation have been achieved at the reduced current density of about 1 ampere per square foot. Series-battery terminal voltages of about 1.5 volts are conveniently achieved in the interests of compactness and converter efficiency. Higher voltages in series systems are achieved with greater cell isolation. Author (TAB)

N68-36498*# TRW Systems, Redondo Beach, Calif.
STUDY OF RADIATION EFFECTS IN LI-DOPED SILICON SOLAR CELLS
J. R. Carter and R. E. Scott 15 Aug. 1968 12 p Prepared for JPL
(Contracts NAS7-100; JPL-952251)
(NASA-CR-97206; TRW-10971-6005-R0-00; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This report covers radiation effects in Li-doped silicon. Initial efforts utilizing $LiAlH_4$ as a diffusion source are promising, but to date have failed to yield surface lithium concentrations in excess of 10^{17} atoms/cm^3. Lang x-ray topography has been attempted to determine whether lithium instabilities at higher temperatures are due to precipitation, outdiffusion, or some other mechanism. Results to date indicate that lithium precipitation producing strained regions greater than 0.1 mm are not observed. Removal rate studies indicate exponential carrier removal as a function of electron fluence in Li-doped float zone silicon, but a linear dependence on electron fluence in crucible grown silicon. Finally, isochronal annealing studies indicate a variety of material dependent effects including relatively low temperature annealing stages and reverse annealing stages. Author

N68-36500*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POWER SYSTEM DESIGN FOR A JUPITER SOLAR ELECTRIC PROPULSION SPACECRAFT
V. Truscello and R. E. Loucks (TRW Systems) 15 Oct. 1968 64 p refs
(Contract NAS7-100)
(NASA-CR-97196; JPL-TR-32-1347) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The design of an electrical power system for a solar electric spacecraft mission to Jupiter is described. The design concept includes a large-area photovoltaic solar array for primary electrical power, a hibernating AgZn battery subsystem for energy storage, and power conditioning equipment for conversion and distribution of power to spacecraft loads. The concept combines a programmed ion engine power consumption profile with a solar panel maximum power point tracker for ion engine control and load matching. This combination minimizes the problem of predicting the solar panel output power available for ion engine consumption as a function of mission time. In addition, the study includes an evaluation of the effects of proton, electron, and micrometeoroid damage on the performance of the solar array. Author

N68-36501*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FIRING SQUIBS BY LOW VOLTAGE CAPACITOR DISCHARGE FOR SPACECRAFT APPLICATION
J. E. Earnest, Jr. and A. J. Murphy 15 Oct. 1968 15 p refs
(Contract NAS7-100)
(NASA-CR-97214; JPL-TR-32-1230) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The design of low voltage capacitor-discharge circuits for firing hot bridgewire (HBW) squibs requires that squib thermal and circuit electrical time constants be considered as interrelated. These functional relationships are analyzed by use of an electrothermal analogy with one composite time constant. The effects of secondary characteristics not considered in the simple analogy are also discussed. Author

N68-36588*# Melpar, Inc., Falls Church, Va.
ELECTROCHEMICAL CELLS FOR USE IN A BALLOON ENVIRONMENT Final Report
[1968] 62 p ref
(Contract NAS5-11548)
(NASA-CR-97219) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Preliminary evaluation of a new solid state electrochemical system is reported. The open circuit voltage is 0.9 to 0.98 volts per cell with maximum current density of 25 ma/cm^2. The system is

rechargeable and, for extended cycle life, can deliver current densities in excess of 300μA/cm^2 at both 25°C and 0°C. At −20°C operation at 100uA/cm^2 with recharging is obtained. The theoretical energy density of 60 watt hours per pound of active ingredients, as well as low temperature operation, absence of liquid electrolyte, and the thin foil structure, make further investigation attractive. The indicated low weight aspect density and high frangibility should lead to a nonhazardous package. Author

N68-36593*# Texas Instruments, Inc., Dallas.
LITHIUM DIFFUSED SOLAR CELLS Quarterly Report, 1 Apr.–30 Jun. 1968
Don L. Kendall and James K. Fisher Jul. 1968 14 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952248)
(NASA-CR-97212; Rept.-03-68-57; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Recovery data of previously produced lithium-diffused solar cells were analyzed after irradiation with high-energy electrons. These analyses resulted in a change in the type of cell blank used for lithium diffusion. Solar cells were made of quartz-crucible, and Lopex silicone. Electrical characteristics of these cells are presented. Future cells will be fabricated using float-zoned silicon, as well as varied base and doping processes. Also, several samples of lithium-diffused silicon of various resistivities were prepared in a Hall bar configuration and tested. Author

N68-36618*# Ryan Aeronautical Co., San Diego, Calif.
FEASIBILITY STUDY, 30 WATTS PER POUND ROLLUP SOLAR ARRAY Final Report
R. D. Allen, R. E. Williams, B. Lake, and A. J. Wellman 21 Jun. 1968 337 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951971)
(NASA-CR-97205; Rept.-40067-4) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A preliminary design of the selected 30-watts/pound rollup solar array is evaluated. Supporting technical analyses including electrical, loads, dynamics, stress, weights and thermal have been performed. The selection of materials and processes and the manufacturing feasibility have been investigated and fulfill the state of the art constraints of the Design Specification. Special support equipment has been identified for handling the flexible solar panels and the complete array. Significant engineering tests were performed to substantiate the analytical approach and to verify the solar array design. A full scale model was fabricated and demonstrated to illustrate the deployment/retraction characteristics of the design. The selected solar array design produces 31.16 watts of power per pound of weight as established from a detail weights analysis and a solar cell electrical ouptut of 10-watts/square foot at air mass zero. Author

N68-36630*# Fairchild Hiller Corp., Germantown, Md. Space and Electronics Systems Div.
FABRICATION FEASIBILITY STUDY OF A 30 WATT/POUND ROLLUP SOLAR ARRAY Final Report
W. G. King 15 Aug. 1968 114 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951969)
(NASA-CR-97208; Rept.-652-00101-FR) CFSTI: $3.00 CSCL 10A

The results of a study to determine the feasibility of fabricating a 250 square foot roll-up solar array capable of producing 30 watts/lb. or more of electric power are summarized. Three candidate structural systems having array deployment and retraction capability were evaluated in depth through parametric investigation of the various subsystems with weight minimization as the prime criteria. The study culminated in selection of an array panel deployment/structural support system consisting of a folding beam using programmed joint motion. A preliminary design of the selected concept is presented with results of a deployment/retraction test program conducted on a full scale mechanically functioning model. Author

N68-36645# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF THE CHARACTERISTICS OF A SINGLE-CIRCUIT SPACE POWERPLANT WITH A THERMOELECTRIC CONVERTER [ANALIZKHARAKTERISTIK ODNOKONTURNO I KOSMICHESKIO ENERGOUSTANOVKI S TERMOELEKTRICHESKIM PREOBRAZOVATELEM
G. A. Varshavskii and N. A. Rezgol Oct. 1967 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (USSR), no. 1, 1967 p 120–126
(FTD-HT-23-796-67; AD-673755)

Thermoelectric power converters for space applications are grouped into four types according to the method of heat transport: a dry system in which the hot and cold junctions are in direct contact with the heat source and the radiator; a single loop system with a hot heat transfer agent; and a single loop system with a cold heat transfer agent and a two-loop system. Author (TAB)

N68-36657*# Electric Storage Battery Co., Raleigh, N. C. Exide Missile and Electronics Div.
DEVELOPMENT OF IMPROVED SEALED Ag-Zn BATTERY FOR MARINER 1969, PART 1, 6 NOVEMBER 1967–3 MAY 1968
A. M. Chreitzberg 19 Aug. 1968 39 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951927)
(NASA-CR-97211; ESB-E-24-68) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Mariner '67 cells have been modified to improve seal reliability, charge acceptance, and "g" level vibration capability. Epoxy plate-locks on each side of the plate pack at the inside bottom of the cell jar together with an omega bend in the plate leads have effectively increased vibration "g" level capability above the 20 "g" rms anticipated for Mariner '69 type approval tests. The epoxy selected for the plate-lock interacts with 45% KOH electrolyte and the negative plates to accelerate hydrogen evolution at 140°F. Cell pressures reach an equilibrium value of 35–40 psig during a 14-day charged stand at 140°F. Highest pressures are achieved by an immediate high temperature exposure after a top-off charge. It is recommended that several chemical types of epoxies and catalysts be tested to find a combination that is stable chemically in 45% KOH, provides mechanical support for the plate pack, and does not accelerate hydrogen gassing rates. Author

N68-36908# California Univ., Livermore. Lawrence Radiation Lab.
OUT OF CORE THERMIONIC SPACE POWER
William E. Loewe 8 Mar. 1968 10 p refs Presented at the 2nd Intern. Conf. on Thermionic Power Generation, Stresa, Italy, 27–31 May 1968
(Contract W-7405-ENG-48)
(UCRL-70816; CONF-680508-1) CFSTI: HC $3.00/MF $0.65

A survey of conceptual out-of-core thermionic systems using heat pipes has been made to identify critical technology areas, investigate feasibility for space application, locate parameter regimes of interest, and estimate specific mass values. The survey included preliminary comparisons of required, current, and projected state-of-art in these critical areas of technology. Temperatures and powers were surveyed in the ranges from 1400°K to 2200°K and from .010 MW(e) to 10MW(e), respectively. A cylindrically

symmetric geometry with a linear display of system components was studied. In general, out-of-core thermionic systems with heat pipes appear to be attractive candidates for use in space over a broad range of electric power levels, meeting the requirements of both advanced auxiliary power and nuclear (electric) propulsion. Author (NSA)

N68-37031# European Space Technology Center, Noordwijk (Netherlands).
PROBLEMS OF SOLAR CELL TESTING
G. Seibert Paris ESRO May 1968 30 p refs
(ESRO-TM-133(ESTEC)) CFSTI: HC $3.00/MF $0.65

The problems posed by solar cell testing are discussed. The topics considered include instrumentation for accurate prediction of I-V-characteristics; artificial light sources commonly used to measure solar-cell output in the laboratory and methods of calculating the output of a cell on a satellite based on such laboratory measurements. Advantages and disadvantages of various methods of testing solar cells are presented. Author (ESRO)

N68-37035# Liège Univ. (Belgium). Inst. of Astrophysics.
PULSES GENERATED BY IONIZING RADIATION IN PHOTOMULTIPLIER TUBES [IMPULSIONS ENGENDREES PAR DES RADIATIONS IONISANTES DANS LES TUBES PHOTOMULTIPLICATEURS]
P. Macar and J. P. Macau Paris ESRO Jan. 1968 28 p refs
(ESRO-SM-72) CFSTI: HC $3.00/MF $0.65

The utilization of photomultiplier tubes in pulse-counting systems, in nuclear physics as well as in satellites, makes necessary the study of their behavior in the presence of ionizing particles. It seems in fact that, when these tubes are subject to bombardment by such particles, the output signal changes on a wide scale. The first part of this paper is a theoretical study of phenomena liable to change the output of the photomultiplier. Some ASCOP tubes (types 542F and 542G) were subjected to α, β, and γ radiation. The results confirmed the previsions, i.e. that, for a given energy, tubes are more sensitive to α and β particles than to γ-rays. Moreover, considering their sensitivity to radiation, the utilization of tubes with sapphire window is to be excluded. Author (ESRO)

N68-37130# Royal Aircraft Establishment, Farnborough (England).
THE ARIEL 3 POWER SYSTEM
F. C. Treble, R. C. Cook and P. G. Garratt Mar. 1968 33 p refs Presented at the Joint IERE/IEE Symp. on Ariel 3 Satellite, London, 13 Oct. 1967
(RAE-TR-68052) CFSTI: HC $3.00/MF $0.65

The solar cell and battery system, which provides power for the experiments, data handling equipment, tape recorder, telemetry transmitter and command receiver on the Ariel 3 satellite, is described, with particular reference to novel features, technological problems and the techniques employed to ensure adequate performance with the utmost reliability. Type approval, selection and flight acceptance test procedures are outlined and data on the performance of the system before and after launch are presented. Author (ESRO)

N68-37162*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTION OF WINDAGE POWER LOSS IN ALTERNATORS
James E. Vrancik Washington Oct. 1968 21 p refs
(NASA-TN-D-4849) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The purpose of this report is to develop a method of predicting the windage loss of rotating electrical machines operating in various gases under different pressures and temperatures. An equation was developed for a cylindrical rotor and modified by empirical relations to take into account the effects of the salient poles and shrouds of the homopolar inductor alternator. The effect of the gap length is briefly studied. The windage loss for a shrouded homopolar inductor alternator was calculated by these equations and compared to the experimental results obtained at the NASA Lewis Research Center. The agreement was within ±10 percent for a range of pressure from standard atmospheric to 40 psia (2.75×10^5 N/m^2). Author

N68-37217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LENGTH OF WINDING ON A TORUS IN TWO IDEAL MODELS
Janis M. Niedra Washington Oct. 1968 16 p
(NASA-TM-X-1674) CFSTI: HC $3.00/MF $0.65 CSCL 09A

An analysis of the relation of the total number of turns on a torus to the length of winding is presented for two models. One model is based on the assumption of circular turns; the other assumes close packed windings. Results are presented for ratios of major to minor radii of the torus of 1.25 to 10 and for fractional filling of the winding window from 0 to 1.0. The curves presented enable the winding length for a particular number of turns to be easily determined. Author

N68-37242*# Martin Co., Denver, Colo.
THE STUDY OF OPTIMIZATION OF THRUST VECTOR CONTROL SYSTEMS
J. E. Wathen, J. W. McIntosh, and M. Nakai Sep. 1967 172 p refs
(Contract NAS8-21041)
(NASA-CR-98032; MCR-67-239) CFSTI: HC $3.00/MF $0.65 CSCL 17G

In relation to the coast or on-orbit phase of the Saturn S-4B stage operation, efforts were undertaken to determine the reliability of various autopilot configurations which are compatible with a majority voting actuator, and to compare these configurations with the existing S-4B stage autopilot and hydraulic thrust vector control system. Consideration was limited to systems using linear servo actuators, and to minimum modifications of the existing S-4B autopilot. Conceptual design and reliability analyses data are given on each autopilot configuration. A computer program was expanded and modified to update data on environmental conditions, operating times for coast and burn phases, and hydraulic system design parameters for the S-4B stage operation. General operating instructions and a listing of the IBM cards used in the computer program are included. A comparative assessment is presented on the probability of failures of the system configurations for the first burn, coast, second burn, and total flight phase. M.G.J.

N68-37258# Royal Aircraft Establishment, Farnborough (England).
TEST REPORT ON CARBON DIOXIDE POWER PACKS FOR PROSTHESES
A. J. Barter May 1968 38 p Prepared for Biomech. Res. and Develop. Unit of Min. of Health
(Contract WO/60/8091)
(RAE-TR-68135) CFSTI: HC $3.00/MF $0.65

Preliminary proving tests are described carried out under R.A.E. Contract WO/60/8091 on three prototype carbon dioxide power packs for artificial limbs designed by the Biomechanical Research and Development Unit of the Ministry of Health. The results of the tests are presented and some design recommendations based on these results are made. Author (ESRO)

N68-37263*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A 5-INCH (13 cm) AXIAL-FLOW TURBINE OVER A RANGE OF REYNOLDS NUMBER
Samuel M. Futral, Jr. and Donald E. Holeski Washington Oct. 1968 20 p refs
(NASA-TM-X-1679) CFSTI: HC$3.00/MF$0.65 CSCL 10B

The investigation was conducted in argon and over a range of inlet total pressures from 9.5 to 1.3 psia (6.6 to 0.9 N/cm^2 abs). The corresponding Reynolds numbers ranged from 317,000 down to 41,000. Test results showed that efficiencies and equivalent mass flow decreased with decreasing Reynolds number. These decreases in performance were greater than those of a 6.02-in. (15.3-cm) radial-inflow turbine which was designed for the same application. Author

N68-37265*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF FREEZING ON PRIMARY SILVER OXIDE ZINC CELLS
Richard E. Johnson Washington Oct. 1968 11 p
(NASA-TM-X-1681) CFSTI: HC$3.00/MF$0.65 CSCL 10C

An investigation was conducted to determine the effects of freezing on primary silver oxide–zinc cells. Three freezing rates of 4.77° F/min. (2.66 K/min), 0.81° F/min (0.45 K/min) and 0.19° F/min (0.10 K/min) were used. In addition, some cells underwent a slow (28-day) freeze–thaw cycle to −50° F (227° K). No harmful effects were noted, either to the cell itself or its performance. Author

N68-37358 Bolkow Entwicklungen K. G., Munich (West Germany).
METHODS FOR DETERMINING AND IMPROVING THE RELIABILITY OF ELECTRICAL SUPPLY SYSTEMS
Ingo Jaschke 4 Jun. 1968 34 p refs Presented at the Meeting of Specialists on the Reliability of Elec. Supply Systems and Related Electro-Mech. Components for Nucl. Reactor Safety, Ispra, Italy, 27–28 Jun. 1968
(EV-65-0)

The analytical work during design and tests on hardware are applied to methods for determining and improving the reliability of power supply systems. Since these methods are basically applicable to all systems, they are described in general then examined by using particular examples from the aeronautical and space fields. Author

N68-37401*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 29–47 refs (See N68-37397 23-11)

Spacecraft power research is reported which includes studies of: (1) solar cell standardization; solar power system definition; solar cell contacts; power subsystems applicable to the Capsule System Advanced Development project; computer programs for analyzing electronic circuits; electric propulsion power conditioning; Mars spacecraft power systems; planetary solar arrays; and thermionic converter development. S.C.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-38017# Department of Transportation, Washington, D. C. Office of Aviation Medicine.
EFFECTS OF TWO ANTIHISTAMINE-CONTAINING COMPOUNDS UPON PERFORMANCE AT THREE ALTITUDES
E. Arnold Higgins, Audie W. Davis, Jr., Vincent Fiorica, P. F. Iampietro, John A. Vaughan, et al Jun. 1968 17 p refs
(AM-68-15) CFSTI: HC$3.00/MF$0.65

In a study of 45 human subjects it was determined that a compound drug containing the antihistamine phenindamine did not statistically impair performance on a modified Mashburn coordinator. Another compound containing the antihistamine chlorpheniramine did impair performance. Performance was also impaired by increasing altitudes. The combined effects of the chlorpheniramine compound and increased altitude proved more detrimental to performance than the sum of the decrements that each influence caused when encountered separately. Although no significant performance decrement resulted from the administration of the phenindamine compound, undesirable side-effects were noted. Author

N68-38044 Stanford Univ., Calif.
THE THERMODYNAMIC THEORY OF THE ELECTROCAPILLARY CURVE INCLUDING A CONSIDERATION OF VARIATION WITH TEMPERATURE
Hayden Wayland Pitman, Jr. (Ph.D. Thesis) 1967 191 p
Available from Univ., Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-17481

The thermodynamic theory of the electrocapillary curve is developed in a rigorous manner by application of the Gibbs adsorption theorem to the ideal polarized electrode, taking into account the electroneutrality conditions applying to the phase interiors and to the surface layer. A general and exact differential equation for the variation of surface tension is obtained in terms of an experimentally observable set of independent variables consisting of the following properties: temperature, pressure, the molalities of the components of the metallic and nonmetallic phases of the polarized electrode, and the applied EMF. From this equation exact expressions for the variation of the electrocapillary curve with each of these variables are set forth; one of the resulting expressions is the well-known Lippmann–Helmholtz equation relating the slope of the electrocapillary curve to the charge density of the double layer. Dissert. Abstr.

N68-38069 Florida State Univ., Tallahassee.
THE EFFECTS OF REPEATED LOW DOSE X-IRRADIATION ON DISCRIMINATION AND RADIOSENSITIVITY
James Michael Johnson (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-361

Twelve male albino rats were trained on a two bar discrimination task. They were required to emit a specified minimum number of responses to the left bar of a Skinner box and then one additional response to the right bar for each reinforcement obtained. Following initial training, the Ss were divided into four groups of three animals each. Each group was then exposed to 0r (control), 7r (low), 14r (medium) or 21r (high) each day at the rate of 7r per minute. Employing the same discrimination task, behavioral assessments of the radiation effects were calculated for the days of stable responding on two different ratio requirements. Some of the conclusions were that an amount of radiation is less effective when delivered in fractionated doses than a dose of equal magnitude delivered in a single exposure. Also, a history of low-dose exposures sensitizes an animal to later high dose exposure. It makes him less able to sustain the radiation injury. Dissert. Abstr.

N68-36155# Toho Univ., Tokyo (Japan). Dept. of Physiology.
PHARMACOLOGICAL IMPROVEMENT OF CAPACITY OF PULMONARY CIRCULATION AT HIGH ALTITUDE Final Report, Apr. 1967–Apr. 1968
Kazuo Asahina APO San Francisco, Calif. Army Res. and Develop. Group (Far East) Jul. 1968 24 p
(Grant DA-CRD-AFE-S92-544-67-G77)
(ARDG(FE)-FE-348-2-F; FR-2; AD-673742)

The effect of ascorbic acid on increasing tolerance to hypoxia has been proved. The noticeable findings have been found in our experiments; (1) ascorbic acid moves from organs to blood in hypoxia and (2) the proportion of oxydized ascorbic acid is much larger in the heart than any other organs in hypoxia. The explanation for these findings have not yet been given. However, these results suggest that there may be some important relationship between ascorbic acid and heart activity which was proved in our previous experiments to be the most significant factor limiting the altitude tolerance. Author (TAB)

N68-36172*# General Dynamics/Convair, San Diego, Calif.
FEASIBILITY STUDY OF A CENTRIFUGE EXPERIMENT FOR THE APOLLO APPLICATIONS PROGRAM. VOLUME 4: MANNED CENTRIFUGE TEST REPORT Final Report
J. F. Brady et al 15 Aug. 1968 76 p refs
(Contract NAS1-7309)
(NASA-CR-66684; GD/C-DCL-68-004; SRC-MS-302) CFSTI: HC$3.00/MF$0.65 CSCL 06P

This study examines the application of an on-board centrifuge as a versatile research tool for the measurement of human physiological responses in the space environment. A realistic orbital centrifuge is configured based on a specified series of experiments dealing primarily with vestibular and cardiovascular physiology. Experiment feasibility is established in terms of spacecraft stability, reliability, safety, economics, weight, power and other influential factors. A ground based prototype of the orbital machine is defined and the required test prgram outlined. The effect of cross-coupled angular accelerations induced by the interaction of the astronaut/machine/vehicle motions is examined by a series of ground centrifuge tests with human subjects. Author

N68-36235# Technische Hochschule Munchen (West Germany).
PREPARATION AND REACTIONS OF C-PERFLUORALKYL-GLYCINE [DARSTELLUNG UND REAKTIONEN VON C-PER-FLUORALKYL-GLYCINEN]
Walter Oettmeier (Ph.D. Thesis) 8 Jul. 1968 83 p refs In GERMAN
CFSTI: HC$3.00/MF$0.65

Free 2, 2, 2 trihalogen N acyl acetaldimines were prepared from 1, 2, 2, 2 tetrahalogen N acyl ethylamines through separation of hydrogen halide with triethylamine in absolute tetrahydrofuran under nitrogen. Also obtained were 3, 3, 3 trifluor 2 aminopropion acid (trifluoralanine), 3, 3, 4, 4, 4 pentafluor 2 aminobutyric acid, and 3, 3, 4, 4, 5, 5, 5 heptafluor 2 aminovalerian acid (heptafluornorvaline) in racemic form by means of addition reactions of vinylmagnesium bromide with N-acylaldimines, oxidation of the vinyl group to the carboxyl group, and separation of the acyl rest. Similarly and starting with hexafluorglutar acid dichloride, the preparation of 3, 3, 4, 4, 5, 5 hexafluor-2, 6 dibenzaminopimeline acid was accomplished. The synthesis of 3, 3, 3, trichloro 2 aminopropion acid (trichloroalanine) was identical with that of trifluoralanine. The chemistry of the trifluoralanine was investigated as an example of the reactions of the C-perfluoralkylglycines. Normal acylation and esterization were possible, and the formation of a crystalline dicyclohexylammonium salt resulted. Transl. by K.W.

N68-36248# Joint Publications Research Service, New York.
PROBLEMS OF SPACE RESEARCH INVESTIGATED
18 Sep. 1968 23 p Transl. into ENGLISH from Nauk i Zhizn' (Moscow), no. 3, 1968 p 25–29, 110–111
(JPRS-46446) CFSTI: HC$3.00/MF$0.65

CONTENTS:
1. SCIENTIST REVIEWS PROBLEMS OF SPACE PSYCHOLOGY V. Lebedev p 1–12 (See N68-36249 23-04)
2. HOW MAN MIGHT COMMUNICATE WITH OTHER PLANETS D. Kulin p 13–18 (See N68-36250 23-07)

N68-36249# Joint Publications Research Service, New York.
SCIENTIST REVIEWS PROBLEMS OF SPACE PSYCHOLOGY
V. Lebedev *In its* Probl. of Space Res. Invest. 18 Sep. 1968 p 1–12 (See N68-36248 23-04)

Psychophysiological factors affecting interplanetary spacecrews are reviewed. The electromagnetic field influence on mental processes is examined, and it is hypothesized that a system of bioelectrical potentials, located on body surfaces, interacts with the earth's magnetic field. A general physiological mechanism of a conditioned time reflex (biological clock) is considered in terms of the effect of the pulsating geomagnetic field. An understanding of these phenomena is necessary to explain the effects of the absence or variations of terrestrial magnetism on the processes of cosmonauts. An evaluation of the periodical rhythm of plant and animal life activities and its interruption led to the conclusion that a sound rhythm activity must be established for crew members to maintain high operational capabilities and to raise the reliability of the man–automaton system. B.P.

N68-36318*# Aztec School of Languages, Inc., Acton, Mass.
EFFECT OF GAMMA-RADIATION FROM COBALT-60 ON THE PROCESS OF OVULATION, FERTILIZATION, AND EMBRYONIC DEVELOPMENT OF A FROG [VLIYANIYE GAMMA-IZLUCHENIY CO 60 NA PROTSESS OVULYATSII, OPLODOTVORENIYE I EMBRIONAL'NOYE RAZVITIYE LYAGUSHKI]
A. V. Voyno-Yasenetskiy Washington NASA Oct. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 100, no. 2, 1955 p 389–391
(Contract NASw-1692)
(NASA-TT-F-11966) CFSTI: HC$3.00/MF$0.65 CSCL 06R

The paper discusses the effect of penetrating radiation from cobalt-60 on the ovulation, fertilization, and embryonic development of a frog. Particular significance is given to the role of the pituitary gland of the mother organism. It is established that the embryonic development of a frog is particularly affected by irradiation both of the females and of the males. Author

N68-36356*# Institute of Modern Languages, Inc., Washington, D. C.
LOWER-BODY DECOMPRESSION FOR THE TREATMENT OF LUNG EDEMA
A. Buhlman NASA Aug. 1968 2 p ref Transl. into ENGLISH from Schweiz. Med. Wochschr. (Basel), v. 98, no. 23, 1968 p 972–973
(Contract NASw-1693)
(NASA-TT-F-11903) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Effect of lower body decompression on blood pressure and lung capacity was studied in five patients who exhibited lung congestion. The body below the diaphragm was enclosed in a plastic bag connected to a common suction pump and a water manometer. Within 15 sec of exposure to pressures of 14 to 30 mm Hg, there was a clearly defined pressure decrease in the lung capillaries and the pulmonary artery. Pressure in the right auricle decreased slightly, pulse rate remained almost constant, and peripheral blood pressure dropped slightly. Elimination of decompression immediately

restored lung circulation. It was found that lower body compression with a negative pressure of 40 to 60 mm Hg affected diaphragm mobility and resulted in a deterioration of ventilation. M.W.R.

N68-36455# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

BIOLOGICAL INDICATORS OF ENVIRONMENTAL RADIOACTIVITY

R. S. Harvey 3 Jan. 1968 9 p refs Presented at the Health Phys. Soc. Symp. on Environ. Surveillance in the Vicinity of Nucl. Facilities, Augusta, 24–25 Jan. 1968

(Contract AT(07-2)-1)

(DP-MS-67-99; CONF-680108-11) CFSTI: HC$3.00/MF$0.65

Monitoring the uptake of radionuclides by biota in the environs of a nuclear facility is an important part of environmental surveillance because many of these organisms may be in the food web of man. Although each new facility must develop a monitoring program to suit the nature of its releases and its environment, much use can be made of radioecological data developed at exiting facilities to determine the kinds of organisms that should be samples. Criteria are discussed for the selection and use of specific organisms to indicate the radionuclide content in various segments of man's food web in the environs of the Savannah River Plant. Author (NSA)

N68-36472# Brookhaven National Lab., Upton, N. Y. Medical Research Center.

INFLUENCE OF EXTRACORPOREAL IRRADIATION OF THE BLOOD AND LYMPH ON LYMPHOPOIESIS AND IMMUNITY

Eugene P. Cronkite, Arjun D. Chanana, Darrel D. Joel, Kanti R. Rai, and Lewis M. Schiffer 25 Mar. 1968 25 p refs Presented at the IAEA Symp. on the Effects of Radiation on Cellular Proliferation and Differation, Monaco, 1–5 Apr. 1968 Sponsored by AEC

(BNL-12300; SM-103/18; CONF-680413-1) CFSTI: HC $3.00/MF$0.65

The theoretical and practical aspects of extracorporeal irradiation of blood and lymph are reviewed. The following studies are included: size of intravascular and extravascular pools of lymphocytes; average time spent by lymphocytes in blood; rate of mobilization of lymphocytes from tissue; lymphocyte production rates; function of lymphocytes; comparison of preceding variables in leukemic and normal animals of the same species; factors controlling lymphopoiesis; role of the lymphocyte in immunologic processes; and as a possible adjunct to aid in the allotransplantation of tissues and organs. This technique is extremely useful in delineating basic lymphocyte physiology and immunology and is a powerful tool for the investigation, either alone or in conjunction with cell labeling studies, of normal and leukemic kinetics. NSA

N68-36568*# Mayo Association, Rochester, Minn.

STUDIES OF THE EFFECTS OF GRAVITATIONAL AND INERTIAL FORCES ON CARDIOVASCULAR AND RESPIRATORY DYNAMICS Semiannual Status Report, Period Ending 1 Oct. 1968

Earl H. Wood 1 Oct. 1968 22 p refs

(Grant NsG-327)

(NASA-CR-97192) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Biplane roentgen videometry for dynamic studies of the size and shape cardiac chambers was developed, along with computer methods for two and three dimensional dynamic and stop motion displays of the data obtained. Other projects to study the effects of the gravitational-inertial force environment on the cardiopulmonary system of animals are underway. Hydraulic properties of the pleural space, regional differences in pleural and esophageal pressures in head-up and head-down positions, position dependent regional differences in pericardial pressure, and influence of body position on regional pulmonary arterial-venous shunts were investigated in dogs without thoractomies. Effect of gravitational and inertial forces on the regional distribution of pulmonary blood flow was studied in chimpanzees using a radioactive microsphere scintiscanning technique, and transient changes in stroke volume from the aortic pressure pulse were determined. Timing of left ventricular end-diastole was studied in dogs with chronic heart blocking. Low bandpass filters were designed for selective discrimination against high frequency noise to physiological signals. M.W.R.

N68-36571*# General American Transportation Corp., Niles, Ill. General American Research Div.

STUDY FOR EVALUATION OF INCINERATION AND MICROWAVE TREATMENT OF HUMAN FECAL MATTER FOR SPACECRAFT OPERATION

T. L. Hurley, E. J. Rollo, and G. A. Remus [1968] 71 p

(Contract NAS2-4438)

(NASA-CR-73247) CFSTI: HC$3.00/MF$0.65 CSCL 06K

Incineration and microwave treatment of human feces were studied; influence of pressure, oxygen concentration, temperature, and power level were evaluated; and concentration ranges and identities of the liquid, gaseous, and solid products were established. During incineration, gaseous products of complete oxidation were primarily carbon dioxide and some nitrogen; carbon monoxide, methane, and nitrogen oxides accounted for less than 0.1%. With incomplete oxidation, minor gas concentrations were as high as 20%. Water condensate in both complete and incomplete condensation was generally acidic, with a pH from 1 to 8; and the solid residue was grey-white ash. While the condensate and solid residue were generally sterile, there was bacterial growth in isolated cases that might have been externally introduced. Microwave treatment produced minimal amounts of carbon dioxide, carbon monoxide, methane, and hydrogen sulfide; and pressure affected the process only by lowering the water boiling point. Condensates escaping the reactor appeared sterile, but solid residues were sterile only with maximum boiling. M.W.R

N68-36572*# Presbyterian Medical Center, San Francisco, Calif. Inst. of Medical Sciences.

INVESTIGATION OF THE FEASIBILITY OF AN EXTERNAL BIOSENSOR FOR CONTINUOUS DETERMINATION OF BLOOD OXYGENATION (AND CONCOMITANT HEART RATE AND RESPIRATORY RATE) BASED UPON OPTICAL BACKSCATTER FOR USE IN SPACECRAFT AND AIRCRAFT Final Report, 24 Jun. 1964–1 Nov. 1965

Robert F. Shaw and Wali M. Malik 1 Nov. 1965 153 p refs

(Contract NAS9-2937)

(NASA-CR-92318) CFSTI: HC$3.00/MF$0.65 CSCL 06P

Spectrophotometric studies of whole blood indicated that optical backscatter could be used for measuring oxygen saturation of blood samples by implementing an optical geometry in which volume illuminated by the light source and blood volume viewed by the photometric sensor were congruent. Such a method was unsatisfactory for in-vivo measurements in humans and animals because of excessive signals that could not be separated from the signal-bearing photic energy returned from the blood. Signal-to-noise ratio was found to be approximately 1:7. Non-congruent external backscatter mode transducers, however, demonstrated sufficient sensitivity and signal-to-noise characteristics necessary for an external biosensor. Variations in physical and optical coupling of the transducers to the subjects were the chief problem for both backscatter and transmissive external biosensors. External backscatter-mode biosensors were more flexible in terms of positioning and more comfortable than classical transmission-mode devices, but both the backscatter and classical modes exhibit the same perturbations in output caused by variations in pressure, position, and motion. M.W.R.

N68-36637# Howard Univ., Washington, D. C. Dept. of Biochemistry.
CHEMICAL EFFECTS OF IONIZING RADIATIONS ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES Annual Progress Report, 1967–1968
Felix Friedberg 30 Nov. 1967 6 p refs
(Contract AT(30-1)-2735)
(NYO-2735-8) CFSTI: HC $3.00/MF $0.65

Progress is reported in studies on the effects of γ radiation on the induction of changes in the molecular weight of individual amino acids within intact and pure protein molecules. Exposure of native ribonuclease or lysozyme in the dry state in vacuo to γ radiation caused formation of higher molecular-weight components of the protein molecules but no evidence of degradation of protein molecules was observed. Exposure of alkylated form of rubonuclease or lysozyme to γ radiation caused formation of smaller molecular-weight components of the protein molecules. NSA

N68-36674 State Univ. of Iowa, Iowa City.
THE EFFECTS OF FOUR WEEKS OF CENTRIFUGATION ON CARDIOVASCULAR FUNCTION IN THE ALBINO RAT
Brian Russell Duling (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16789

Male Simonsen albino rats weighing 260–300 g at the onset of exposure were centrifuged at 3.2 G's (36.1 rpm) for four weeks. After centrifugation the animals were removed and anaesthetized with sodium pentobarbital administered intraperitoneally. Measurements were made on: systemic blood pressure, resistance of the perfused hind end vascular bend, and the characteristics of vascular reflex control. Vascular reflex changes, in response to systemic pressure alterations induced by epinephrine or acetylcholine, were compared in 12 centrifuged and 12 noncentrifuged animals. Centrifuged rats exhibited a significantly greater alteration in peripheral resistance for a given change in systemic pressure. These results are discussed in terms of their implications with respect to the interaction between the inertial field and cardiovascular function. Dissert. Abstr.

N68-36719# Brookhaven National Lab., Upton, N. Y.
RELATION OF IRRADIATION DOSE-RATE EFFECTS IN MAMMALS AND IN MAMMALIAN CELLS
J. L. Bateman [1968] 20 p refs Presented at the Symp. on Dose Rate in Mammalian Radiation Biology, Oak Ridge, Tenn.
(BNL-12581; CONF-680410-4) CFSTI: HC $3.00/MF $0.65

Data of other investigators were utilized to derive and present certain features of mammalian cell and animal survival after exposure to ionizing radiations. Survival of cells tends, as it decreases, towards an exponential relation to dose. The dose to produce a constant level of survival tends, with decreasing survival, towards a linear relation to the reciprocal cube root of dose rate. Survival of small mammals, expressed in probits, appears to be linear on reciprocal dose. Regressions for various dose rates appear to be parallel. The dose to produce 50% survival bears a linear relation to the reciprocal cube root of dose rate. Species specificity appears to be expressed for animals by different slope constants (K) relating the LD_{50} to the reciprocal cube root of dose rate. Strain specificity appears to be characterized within one species by the infinite dose rate intercept of the extrapolated straight best fit line of LD_{50} on the reciprocal cube root of dose rate. NSA

N68-36748*# Public Health Service, Phoenix, Ariz. Planetary Quarantine Unit.
SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS OF NASA Progress Report, 1 Jul.–30 Sep. 1968
M. S. Favero Sep. 1968 28 p
(NASA Order R-137)
(NASA-CR-97152; Rept.-23) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Studies were continued on the evaluation of the vacuum probe for sampling surface contamination. The probe technique was compared with the standard strip assay procedure for recovering *Bacillus subtilis* var. *niger* spores and naturally occurring microorganisms in dust from stainless steel strips. The dust was prepared by sifting a fresh soil sample, collecting the fraction that passed a 125 μ screen, and drying this fraction at 50 C for 48 hours to reduce the vegetative microbial population. A summary of all comparisons made to date is presented. Although no explanation can be offered for the differences in recovery rates for the three sets of experiments, all rates were considered relatively high compared with those achieved with other sampling procedures currently in use. The relatively good agreement between the coefficients of variation for the probe and the standard strip assay procedure in each set suggested that the probe accurately reflected the inherent variation in the deposition of fallout contamination. Author

N68-36755*# Institute of Modern Languages, Inc., Washington, D. C.
PULMONARY EDEMA IN UREMIA [LUNGENOEDEM BIE URAEMIE]
A. Buhlmen NASA Aug. 1968 2 p ref Transl. into ENGLISH from Schweiz. Med. Wochschr. (Basel), v. 98, no. 23, 1968 p 872–873
(Contract NASw-1693)
(NASA-TT-F-11904) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Pulmonary edema can be a complication of acutely worsening uremia. The mechanism of its origin is complex and obscure. The author measured the circulation pressure of 7 uremic patients with roentgenological symbols. In 5 cases a slightly increased median pressure of 20 to 30 mm Hg was found, while pressure in the right auricle was normal, which is the argument against over-hydration as a causative factor. No decrease of pressure was found after peritoneal or hemodialysis respectively. The author interpreted these findings as left cardiac insufficiency. Roentgenologically, 5 out of 5 patients also showed a considerable enlargement of the heart as well as circulatory hypertomia. Author

N68-36759# Johns Hopkins Univ., Baltimore, Md. Dept. of Biochemistry.
ON EFFECTS OF ULTRAVIOLET RADIATION ON NUCLEIC ACIDS AND RELATED COMPOUNDS Progress Report, Dec. 1, 1966–Nov. 31, 1967
Shih Yi Wang Sep. 1967 18 p
(Contract AF(30-1)-2798)
(NYO-2798-32) CFSTI: HC $3.00/MF $0.65

Ultraviolet radiation effects on nucleic acids and related compounds were investigated. Radio-induced formation of cyclobutyl dimers and thymine products in deoxyribonucleic acid was studied, as were the mechanisms of photochemical reactions in pyrimidines. Photochemistry of derivatives of 5-bromo-uracil and thymine in aqueous solutions was studied. NSA

N68-36760# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TABLES OF BETA DOSE DISTRIBUTIONS
William G. Cross Nov. 1967 32 p refs
(AECL-2793) CFSTI: HC $3.00/MF $0.65

Tables are given of dose distributions near isotropic point and plane beta sources in air and water for 37 nuclides of importance in medicine and health physics. These were calculated from Spencer's dose distribution tables for monoenergetic electrons. A simple method is given for deriving dose distributions in other low-Z media. Author (NSA)

N68-36766# Sensory Systems Lab., Tucson, Ariz.
EXPERIMENTAL STUDIES ON ECHOLOCATION MECHANISMS IN BATS Final Report, Jul. 1965–Jul. 1967
Frederic A. Wesbter and Oliver G. Brazier May 1968 165 p refs
(Contract AF 33(615)-2964)
(AMRL-TR-67-192; AD-673373)

Comparative pursuit studies carried out on three species (Myotis lucifugus, Eptesicus fuscus and Lasiurus borealis) revealed similar tactics of pursuit and capture in Myotis and Eptesicus. Detection and localization capacities of Eptesicus appeared equal to the other species, but discrimination between spheres and mealworms proved highly variable, and the capacity to capture small targets inferior. Though the measured pursuit signals of the three species had definable differences, the phases of pursuit exhibited common characteristics, adequate for real-time machine identification, and thus usable for pursuit-controlled triggering of stimuli or recording equipment. Echoes returned by objects discriminated by bats have been studied by oscilloscope and human listening. Due to the number of relatively nonfluctuating echoes from mealworms (projected into a sound field of ultrasonic pulses), other details must provide essential clues for the bats observed discriminations. Author (TAB)

N68-36817# School of Aerospace Medicine, Brooks AFB, Tex.
RELATION OF SIGNAL LIGHT INTENSITY TO PHYSIOLOGIC END POINTS DURING $+G_z$ ACCELERATION Final Report, Apr.–Oct. 1967
James D. Rogge May 1968 14 p refs
(SAM-TR-68-38; AD-673480)

Results of previous studies suggest that lowering the luminance of the signal lights lowers the blackout and grayout level during +Gz acceleration. In this study, variations in luminance of the central and peripheral signal lights in the range that is suitable for routine centrifuge operation failed to produce any detectable change in blackout or grayout levels. The visual phenomena described in the previous studies may have arisen mainly from such local changes in the eye as changes in visual threshold, retinal metabolism, and visual acuity; whereas, blackout obtained with light intensities used in this study resulted from hemodynamic changes caused by +Gz acceleration and possibly some local changes in the eye itself. Author (TAB)

N68-36850# Rochester Univ., N. Y. Dept. of Radiation, Biology and Biophysics.
BIOLOGIC EFFECTS OF MICROWAVE EXPOSURE Final Report
Sol M. Michaelson, Roderick A. E. Thomson, and Joe W. Howland 25 Jul. 1967 131 p refs
(Contracts AF 30(602)-2248; W-7401-eng-49)
(UR-49-810) CFSTI: HC $3.00/MF $0.65

Animals exposed to microwaves at specific frequencies and flux densities experienced thermal stress. Duration of exposure, environmental temperature, and drugs that affect the central nervous system (CNS) and temperature regulation influenced the response of animals. High ambient temperature exaggerated the thermal response, while exposure in a cold environment prolonged the time interval for an increase in body temperature. Microwave effects on hematopoiesis, thyroid function and interaction with ionizing radiation are discussed. Sufficient data were not available to establish a comprehensive safe level for microwave exposure because of microwave frequency related factors that affect biologic response. The subtle nature of some of our findings such as modification of response to x-irradiation and effect on bone marrow and thyroid require careful evaluation. Soviet reports alluded to asthenic reactions, CNS, cardiovascular, and thyroid changes from radar exposure. NSA

N68-36888# Israel Program for Scientific Translations, Ltd., Jerusalem.
TOXICOLOGY OF THE RARE METALS
Z. I. Izrael'son, ed. 1967 224 p refs Transl. into ENGLISH of the book "Toksikologiya Redkikh Metallov" Moscow, Medgiz., 1963 p 1–234 Prepared for AEC and Natl. Sci. Foundation
(AEC-TR-6710) CFSTI: HC $3.00/MF $0.65

Problems of industrial hygiene during the production and use of certain metals, metal alloys, and metal compounds are discussed. Emphasis is placed on the toxicity of inhaled aerosols and dusts to personnel. The metals considered were cadmium, cobalt, copper, barium, molybdenum, nickel, niobium, rare earth metals, tantalum, tellurium, titanium, tungsten, vanadium, zinc, and zirconium. Silicon dusts of various metals are also discussed. NSA

N68-36915# Junta de Energia Nuclear, Madrid (Spain). Seccion de Isotopos.
FOOD PRESERVATION BY IRRADIATION. PART 7: INVESTIGATIONS CARRIED OUT WITH TWO VARIETIES (ALAVA AND GINEKE) OF SPANISH POTATOES [CONSERVACION DE ALIMENTOS POR IRRADIACION. PARTE 7: INVESTIGACIONES REALIZADAS CON DOS VARIEDADES (ALAVA Y GINEKE) DE PATATAS]
A. Garcia de Mateos Lopez, A. Rivas Garcia, N. Ortin Sune, and M. del Val Cob 1967 28 p refs In SPANISH; ENGLISH summary
(JEN-189-SI/I-18) CFSTI: HC $3.00/MF $0.65

Radiation doses from 5 to 50 Krad have been used and during a twelve months' period the effects of gamma radiation on the weight loss, sprouting and spoilage control, texture, ascorbic acid and total carbohydrate content have been studied. Tests of sprouting in field conditions are described. The dose of 8000 rads provided excellent control of sprouting regardless of variety. Author (ESRO)

N68-36999# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FUNDAMENTAL RELATIONSHIPS BETWEEN LINEAR ENERGY TRANSFER, ABSORBED DOSE, KERMA, AND EXPOSURE. APPLICATION TO CHANGES OF MEDIUMS [RELATIONS FONDAMENTALES ENTRE TRANSFERT LINEIQUE D'ENERGIE DOSE ABSORBEE, KERMA ET EXPOSITION APPLICATION AUX CHANGEMENTS DE MILIEUX]
Henri Joffre and Lucien Pages Feb. 1968 39 p refs In FRENCH; ENGLISH summary
(CEA-R-3424)

After briefly defining the quantities used in dosimetry and presenting them with a view to their simple adaptation to health physics problems, simple mathematical relations were established to express the absorbed dose, kerma, and exposure in the case of electrons and photons, and also relations between these various quantities considered in air. The variations in these quantities at the interface between the air and the soft tissues of the organism and in depth in the tissues were studied. The numerical values of the discontinuities liable to appear at the interface and the values obtained, relative to air, after electronic equilibrium is established in depth in the tissues are given. An example of application to dosimetry is also given in the case of an aluminium-walled ionization chamber. Also the conditions to be fulfilled in order to make a direct measurement of the absorbed dose in the tissues are presented and discussed. Author (NSA)

N68-37111# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A METHOD FOR MEASURING SMALL DIFFERENCES OF THE COMPLEX MICROWAVE DIELECTRIC CONSTANT OF

FLUIDS AND ITS APPLICATION TO THE STUDY OF MOLECULAR STRUCTURE OF HEMOGLOBIN [EINE MESSMETHODE FUER KLEINSTE DIFFERENZEN DER KOMPLEXEN GHz-DIELEKTRIZITAETSKONSTANTEN VON FLUESSIGKEITEN ZUR UNTERSUCHUNG VON HAEMOGLOBIN-STRUKTURAENDERUNGEN]

Wolf v. Casimir Jan. 1968 50 p refs In GERMAN; ENGLISH summary

(IPP-3/66) CFSTI: HC $3.00/MF $0.65

The effect of oxygenation on the structure of hemoglobin molecules was investigated by microwave measurements. A measuring method for phase shifts $\leq 0.5°$ (accuracy $\pm 0.01°$) and attenuation differences ≤ 0.1 db (accuracy ± 0.002 db) in high loss fluids was developed using a 3 cm waveguide interferometer with a measuring cell connected to a closed loop circulation system. The resulting differences of the dielectric constant of an aqueous solution of human hemoglobin ($\delta\epsilon' = -0.022 \pm 0.005$ and $\delta\epsilon'' = -0.009 \pm 0.003$) indicate a change in molecular structure due to the oxygenation. Author (ESRO)

N68-37204*# Federal Aviation Agency, Washington, D. C. Office of Aviation Medicine.

THE BIOPHYSICAL BASIS AND CLINICAL APPLICATIONS OF RHEOENCEPHALOGRAPHY

John H. Seipel May 1967 64 p refs

(Grant NsG-388)

(NASA-CR-97261; AM-67-11) CFSTI: HC $3.00/MF $0.65 CSCL 06E

A method for screening large populations for asymptomatic but potentially incapacitating cerebrovascular disease has obvious application in aviation medicine. Rheoencephalography (REG), a simple, rapid and innocuous method of studying the cranial circulation, was investigated for this purpose. A standardized, repeatable method involving tracing during brief arterial compressions was developed and is fully described. A 95% predictive accuracy in diagnosis and localization of carotid occlusive disease is demonstrated in patients with cerebrovascular insufficiency. A significant number of asymptomatic, medically certified normal airmen are found to be potential stroke candidates by the same method. Individual extra- and intra-cranial arterial circulatory components are demonstrated for the first time. Previously reported difficulties in REG diagnosis are elucidated. The potential value of REG screening of normal populations for cerebrovascular anomalies and early disease is demonstrated. Author (TAB)

N68-37285# Joint Publications Research Service, Washington, D. C.

EFFECT OF SUPERHIGH-FREQUENCY ELECTROMAGNETIC FIELDS ON CONDITIONED REFLEX REGULATION OF CARDIAC AND RESPIRATORY ACTIVITY

M. I. Yakovleva 9 Oct. 1968 10 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 18, no. 3 p 418-423

(JPRS-46632) CFSTI: HC $3.00/MF $0.65

An investigation is presented of the effect of superhigh frequency electromagnetic fields on conditioned reflex regulation of cardiac and respiratory activity in rabbits. The cardiac and respiratory functions were judged on the basis of frequency of cardiac contractions and on the frequency and type of respiratory movements. It is concluded that a single exposure to SHF with a power flow density of 5 milliwatt/sq. cm. and a wave length of 12.6 cm does not produce changes in cardiac and respiratory reflexes. SHF fields with a power flow density of 14 to 26 milliwatt/sq.cm. in a single exposure produces increased stability of cardiac and respiratory reflexes. Continuing (1 to 3 months) exposure to SHF fields with a power flow density of 5 milliwatt/sq.cm. produces a higher level of conditioned cardiac response and does not change it. Only one rabbit showed a reduction in the stability of conditioned reflexes which then returned to normal during continuing irradiation. C.T.C.

N68-37345# Joint Publications Research Service, Washington, D. C.

EVALUATION OF THE DEGREE OF ACTIVITY INTENSITY UNDER CONDITIONS OF HYPOXIA AND OXYGEN BREATHING UNDER EXCESSIVE PRESSURE

Ye. V. Bondarev, V. A. Yegorov, and V. N. Kuznetsov 14 Oct. 1968 14 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 4, 1968 p 151-155

(JPRS-46656) CFSTI: HC $3.00/MF $0.65

An investigation is reported to determine the effects of the extreme conditions on the quality of the aircraft pilot's activity and the assimilation rate of additional information when simulating flying activity on the TL-1 flight trainer. The experiments were carried out on 11 persons well experienced in the operation of the trainer. Each person was exposed to 15 minutes of hypoxia corresponding to an altitude of 6200 m or to oxygen breathing at a pressure of 350-400 mm of water, and was tested no more often than twice a week. It was determined that the pilot's activity may be maintained at a fairly high level, but at the expense of greater intensity of activity accompanied by considerable diminution of the psychophysiological reserves of the organism determined by the assimilation rate of additional information. The positive training effect of repeated exposure was established. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-36304 Michigan Univ., Ann Arbor.

MEASURING HUMAN PERFORMANCE WITH A PARAMETER TRACKING VERSION OF THE CROSSOVER MODEL

Glenn Alben Jackson (Ph.D. Thesis) 1967 252 p

Available from Univ. Microfilms: HC $11.50/MicroFilm $3.25 Order No. 67-17783

The purpose of this research is the evaluation of a particular parameter tracking system for use in measuring the performance of human operators in low order compensatory manual control systems. The system is based on a proposed crossover model which assumes that the entire forward loop of the compensatory control system can be represented by a gain, an integration and a pure time-delay. A continuous parameter tracking system is developed using an approximate version of the crossover model as the basic system model. The approximation involves the use of a first order Padé time-delay in place of the pure time-delay. The parameter tracking system is tested on subjects controlling single and double integrator plants, with input signals of bandwidth limited Gaussian noise. It is concluded that, as long as the input bandwidth is properly chosen, the parameter tracking system developed is an excellent method for measuring human performance in certain low order compensatory control systems. Dissert. Abstr.

N68-38316*# Techtran Corp., Glen Burnie, Md.

ON PERCEPTION AND MEASUREMENT OF SOUND LEVEL [UBER EMPFINPUNG UND MESSUNG DER LAUTSTARKE]

Ulrich Steudel Washington NASA Sep. 1968 28 p refs Transl. into ENGLISH from Hochfrequenztech. u Elektroakust. (Leipzig), v. 41, 1933 p 116–128
(Contract NASw-1695)
(NASA-TT-F-11926) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Initially are measured the sound levels of many-fold noises, generally clicks, both single and periodic, either directly through comparison with a 1,000-c/s tone or by the intermediary of another calibrated comparison noise. From the entirety of the measurements, conclusions are then drawn which have as most important result the establishment of a new sound-level formula which furnishes satisfactory approximation values. The formula can also be expanded to noises and tones. The second part indicates an objective sound-level meter and the development of its individual components, which is capable of accurately measuring any sound, even individual clicks. Author

N68-38400# City Univ. of New York. Center for Research in Cognition and Affect.
DETECTION OF AN AMBIGUOUS VISUAL SIGNAL WHILE IMAGING Final Report, Oct. 1967–Jun. 1968
Sydney Joelson Segal Jul. 1968 37 p refs
(Contract F44620-68-C-0013)
(AFOSR-68-1622; AD-673516)

The experiments reported used a simple discrimination task as a baseline, against which to compare the effects of discrimination and imaging. In all the experiments, imaging plus discrimination and discrimination tasks differed significantly in d, regardless of order of presentation, nature of the stimuli, information and familiarity with the stimuli. The d scores for imaging tasks under several conditions were .74, 1.36, 1.61, 1.77, 1.94, and 2.03; for comparable discrimination tasks, d scores were 2.19, 2.68, and 2.71. Response bias (Lx) was also generally higher for imaging, indicating a more conservative criterion. Author (TAB)

N68-38442# Air Force Missile Development Center, Holloman AFB, N. Mex.
A DESCRIPTION AND EVALUATION OF ELECTROENCEPHALOGRAPHIC ANALYSIS TECHNIQUES Technical Report, Mar.–Jul. 1967
Charles E. Todd Sep. 1967 48 p refs
(MDC-TR-67-106; AD-673890)

The report describes and evaluates the data processing procedures and techniques used to qualify and to quantify physiological impairment associated with prolonged sleep deprivation as evidenced by the electroencephalogram. The primary compression of the data was accomplished by computing the power spectra of selected time intervals using digital filters. Consecutive spectral estimates were then used to describe a surface which was contoured and plotted for display. The evaluation of the processing procedures shows the final spectral estimate error to be thirty to fifty per cent of the ideal spectra as a result of a ten to fifteen per cent error in the quantized data being propagated through the digital filters. The data characteristics were determined by autocorrelation and associated statistical functions and the data reduction systems response to these characteristics was investigated. The properties of the data and the limitations of the techniques discussed suggest the need for improved methods for studying the EEG. Author (TAB)

N68-38457*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
USE OF AN ELECTROLUMINESCENT DISPLAY IN MANUAL TRACKING AND IN A READING TASK
Frank Nauman and John D. Foster Washington Oct. 1968 22 p refs
(NASA-TN-D-4841) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The purpose of this research was to determine whether performance differences existed between electromechanical and electroluminescent (EL) displays in a closed loop manual tracking task and in reading accuracy tests. Both displays had vertical scales, which are considered acceptable for spacecraft use. Studies were made with two EL displays, a single-scale, and a double-scale bargraph display. Pursuit tracking of sine and random waves and readability tests were conducted. The double scale instrument was used in the tracking tasks and the single scale instrument in the readability tests. The discreteness of the EL instrument's 128 vertical scale segments (12.6/cm) did not appear to cause any problems in either task. In the tracking tasks, the electroluminescent instruments were comparable to the electromechanical instruments in the region of their flat frequency response. In the readability tests, in which the environmental illumination was changed, readability of the EL instruments reduced rapidly with increasing environmental illumination above 550 lumens/m^2. However, at the low ambient light conditions expected in a spacecraft environment, less than 1 lumen/m^2, the readability was adequate. Author

N68-38461*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A SYNTHESIS OF HUMAN RESPONSE IN CLOSED-LOOP TRACKING TASKS
James J. Adams and Hugh P. Bergeron Washington Oct. 1968 35 p refs
(NASA-TN-D-4842) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Experiments have been conducted to determine the variability in a human subject's control stick response to the stimulus of displayed displacement and of rate of change of displacement to aid in the implementation of the time variations to be included in a linear model of the human subject. Additional tracking tests were made to obtain a definition of the characteristics of the random signal to be added to the model. These two factors, the time variations and the random signal, were then added to the linear model, and the resulting composite model was placed in analog representations of single loop and multiloop systems. The results demonstrate that this composite model reproduces the dynamic characteristics of the time histories and mean square system error which more closely match the response obtained with the human subject than does the linear model. Author

N68-38484# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN EXPERIMENTAL INVESTIGATION OF THE SELF ADAPTION FUNCTIONS OF THE HUMAN OPERATOR [EKSPERIMENTAL'NOYE ISSLEDOVANIYE FUNKTSIY SAMONASTROYKI CHELOVEKA-OPERATORA]
G. A. Sergeyev 18 Sep. 1967 24 p refs Transl. into ENGLISH from Samoobuchayushchiyesya Avtomat. Sistemy (USSR), 1966 p 222–232
(FTD-HT-67-337; AD-673784)

The work examines results of experimental studies of the self-adjusting functions of human operators working at consoles under the effect of nonsteady input signals. The following were investigated: The effectiveness indexes of operator self-adjustment function; The structure of informational elements comprising the cybernetic model of the human operator; and Qualitative characteristics necessary for mathematical and physical simulation of self-adjusting systems. An automatic stochastic regulator system operating under the effect of random input signals was the general model used for output signal analysis. Author (TAB)

N68-38545*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATUS REPORT ON RECENT LANGLEY STUDIES OF LUNAR AND SPACE STATION SELF-LOCOMOTION

Donald E. Hewes Washington Oct. 1967 21 p refs Presented at AGARD 24th Aerospace Med. Panel Meeting, Brussels, 24–27 Oct. 1967
(NASA-TM-X-60686) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Reduced gravity simulators are described which permit the subjects to experience the sensations and physical effects produced by space environments. The lunar locomotion studies are being made on an inclined-plane technique developed for simulating lunar gravity. It was observed that significant differences between earth and lunar locomotive gait characteristics exist, and that a gravity level equal to that of the moon had a favorable effect on these locomotive capabilities. The space station studies utilize a simulator capable of rotation which together with the inclined-plane technique adapted from the Lunar Walking Simulator can provide weightless and rotational conditions. Subjects could initiate and sustain a walk at gravity levels below 0.2 times earth's gravity. In addition to walking, "space soaring" could be employed under these conditions. K.W.

N68-36566*# McDonnell-Douglas Corp., Huntington Beach, Calif. Missile and Space Systems Div.
EVAPORATIVE COOLING GARMENT SYSTEM (ECGS), PART 1 Final Report
J. G. Bitterly Sep. 1968 186 p
(Contract NAS9-7207)
(NASA-CR-92332; MDAC-62364, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 06K

An Evaporative Cooling Garment System (ECGS) demonstrated high cooling rates during simulated 4-hour heavy work load extravehicular activity. Short run cooling rates exceeded 7,000 Btu/hr, with maximum cooling rates instigated in less than 1 sec. Cooling duration was limited only by the cardiovascular system's ability to transmit internal body heat via the capillaries to the skin surface. Heat rejection rates were controlled to less than 1%, and 1,500 Btu/hr of heat rate were stored within the ECGS patches as water. The ECGS displayed mobility limits comparable to that for the full pressure suit, wearing comfort was adequate during long-duration running speeds on a treadmill, and cooling up to 5,000 Btu/hr metabolic rate carried to the limit of human endurance resulted in a no measurable body sweating and maintained thermal equilibrium. The ECGS operates by conducting body heat through a thin membrane that completely encloses a wick water supply, which undergoes low pressure boiloff. M.W.R.

N68-36567*# McDonnell-Douglas Co., Huntington Beach, Calif. Missile and Space Systems Div.
EVAPORATIVE COOLING GARMENT SYSTEM (ECGS), PART 2 Final Report
J. G. Bitterly Sep. 1968 252 p refs
(Contract NAS9-7207)
(NASA-CR-92333; MDAC-62367, Pt. 2) CFSTI: $3.00 CSCL 06K

Details are presented for the various analyses conducted in connection with the testing of an Evaporative Cooling Garment System (ECGS). The ECGS performance and steam line analysis is presented along with the boiler void pressure drop analysis and the steam line pressure drop effects on overall system performance. Biochemical responses to exercise are discussed. Complete data results on a typical design verification test run are presented in the form of 176 graphs. The patterns used for the patches on the ECGS are included. M.W.R.

N68-36681# Princeton Univ., N. J. Dept. of Psychology.
DISPOSITIONAL AND INDUCED INFORMATION PROCESSING STRUCTURES
Robert E. Lee, III (Ph.D. Thesis) Apr. 1968 145 p refs
(Contract Nonr-1858(12))
(TR-18; AD-673677)

In this investigation, short-term training sequences are used to systematically manipulate two major aspects of structural complexity: (1) the number of dimensions of information available to the individual; (2) the level of complexity with which these dimensions are integrated. Ss are 72 undergraduates differing in dispositional conceptual level. The specific experimental concern is the effect of these manipulations upon the ability of these Ss to generate and to entertain alternate perspectives when engaged in a complex problem-solving task. Both training sequence and dispositional conceptual level are found to significantly influence the extent to which the Ss generate alternate perspectives as a strategy of conflict resolution and decision making. However, openness to the perspectives of others is significantly influenced only by conceptual level. Author (TAB)

N68-36700 Baylor Univ., Waco, Tex.
THE EFFECTS OF STRESS OF HUMAN PERFORMANCE OF A TWO COMPONENT TASK
Paul Daniel Jacobs (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17876

Thirty-six human subjects, eighteen males and eighteen females were employed in an investigation of the effects of stress on the performance of continuous and discrete avoidance tasks. The subjects, all volunteers, monitored two visual displays while the three treatment conditions were presented for fifteen minutes each. The treatments consisted of a no-stress condition, a task-related stress condition, and a task-unrelated stress condition. The stressor used in this study was mild electric shock which the subjects reported as being unpleasant but not painful. The dependent variables were simple reaction time, number of cumulative responses, and cumulative response errors (overestimations of continuous avoidance interval). The results indicate that simple reaction time is faster during the task related stress condition than during the other two conditions. No differences in reaction time performance were found between the time intervals when the effects of stress were held constant. Dissert. Abstr.

N68-36748*# Tracerlab., Inc., Richmond, Calif.
RADIO-FREQUENCY PLASMA AND HEAT TREATMENT OF HUMAN FECAL MATTER
Merle M. Millard and Bill B. Stafford Aug. 1968 20 p refs
(Contract NAS2-4702)
(NASA-CR-73249) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Laboratory studies were made to determine the feasibility of adapting the radio-frequency electrodeless discharge method for low temperature ashing of human fecal matter on-board space vehicles. The process assures 100 percent reduction of organic wastes to inorganic forms. The tests were conducted in a 1.5 liter plasma reactor chamber using oxygen, carbon dioxide, hydrogen, water and a carbon dioxide-hydrogen-water mixture. The effects of treatment gas, discharge power, and gas pressure were studied during low temperature plasma ashing of 'normal' fecal material. Author

N68-36808 California Univ., Los Angeles.
CHOICE REACTION TIMES AND CONFIDENCE IN AUDITORY SIGNAL DETECTION
James Mitchell Smith (Ph.D. Thesis) 1967 318 p
Available from Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 68-240

Two preliminary studies and one main study were run using a modified Yes–No procedure in which trial pacing and duration of the stimulus presentation were subject-determined. Subjects initiated stimuli presented on trials and terminated them by making choices as to which stimuli were being presented. The time between onset of a stimulus presentation and its termination, that

is, onset of the choice, constituted the choice reaction time for that trial. On each trial, the stimulus presented was either white noise alone (No Tone) or white noise with a 1000 cps tone added (Tone) and the choice made was either a Yes or a No. After his choice, the subject received feedback as to whether or not he was correct. In the second study each subject also indicated his confidence (High, Medium, or Low) in his choice prior to feedback. In the main study, in which confidence was also recorded, 6 paid subjects were run for an extended number of sessions under each of three probability conditions (.2, .5, and .8) for a Tone trial. Dissert. Abstr.

N68-36873# Rochester Univ., N. Y. Dept. of Radiation, Biology and Biophysics.
COMPUTER CONTROL OF BEHAVIORAL EXPERIMENTS
Louis Siegel 27 Jul. 1967 11 p Presented at the Am. Psychological Assoc. Meeting, Washington, D. C., 3 Sep. 1967
(Contract W-7405-ENG-49)
(UR-49-814; CONF-670918-1) CFSTI: HC$3.00/MF$0.65

It is shown how the LINE computer goes about executing a particular schedule of reinforcement, a Fixed Ratio 7, for behavioral experiments. NSA

N68-36877# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
APPLICATION OF THE RANQUE-HILSCH VORTEX TUBE TO AIRCREW COOLING PROBLEMS Final Report, Feb.–May 1967
Robert E. Van Patten and Ralph Gaudio, Jr. Jun. 1968 19 p refs
(AMRL-TR-67-124; AD-673345)

The Ranque–Hilsch vortex tube, a device with no moving parts, produces significant refrigeration effect when driven by compressed air. This report disseminates up-to-date information on the performance of current vortex tubes, reports the results of an aircrew cooling experiment using the device, and suggests other uses of potential interest to the Air Force. The history of the vortex tube and its basic theory are presented briefly. Author (TAB)

N68-37139# Aeronautical Research Council (Gt. Brit.)
FURTHER ANALYSIS OF TSR 2 FLIGHTS THROUGH TURBULENCE
T. B. Saunders 1968 43 p refs Supersedes S&T-Memo-3/67; ARC-29469; See X68-10056
(ARC-CP-997; S&T-Memo-3/67; ARO-29469) CFSTI: HC $3.00/MF$0.65

Human pilot describing functions are derived from records of two flights through turbulence by the TSR 2 based on the assumption of the use of pitch rate cues and normal acceleration cues respectively. No indication can be gained of the validity of these assumptions. Small, low frequency errors in pitch rate introduced during trace readings were magnified by subsequent integration and produced large errors in the time histories of vertical gust velocity at very low frequencies. This prevented the estimation of turbulence power spectra. Author (ESRO)

N68-37224# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
OPTIMAL TIME ALLOCATION IN COMPLEX TASKS
Ronald R. Yager Jun. 1968 236 p refs
(Contract AF 49(638)-1402)
(PIBEE68-0006; PIBMRI-68-1388; AFOSR-68-1192; AD-673891)

The thesis studies the problem-solving situation from an input-output point of view, with emphasis on the following two aspects. First, the expected payoff is related to the time spent analyzing the various components of the problem. Second, the optimal allocation of a finite amount of time among m independent problems is derived in terms of the complexities of the problems, and the correlation between each problem and the problem solvers ability and experience. By alluding to the stochastic theory of learning it is shown that, in general, the expected payoff in a problem-solving situation is a concave function of time satisfying four conditions. Justifications are given for the approximation of the payoff by an exponential function of time. The theory of hypothesis testing in the presence of white Gaussian noise is also used to verify these assumptions about the functional form of the expected payoff. Author (TAB)

N68-37225# International Atomic Energy Agency, Vienna (Austria).
SOLID-STATE DOSIMETRY
1967 143 p refs *Its* Bibliographical Series No. 23
(STI/PUB-21/23) Available from Intern. Atomic Energy Agency: $3.00

Seven hundred and fifty-four references are presented on various aspects of solid-state dosimetry. Author and keyword indexes are included. NSA

N68-37370*# Midwest Research Inst., Kansas City, Mo.
BIOMEDICAL APPLICATIONS OF AEROSPACE GENERATED TECHNOLOGY Quarterly Report, 1 Jun.–31 Aug. 1968
David Bendersky 31 Aug. 1968 51 p refs
(Contract NSR-26-002-083; MRI Proj. 3217-E(A))
(NASA-CR-97266; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Nineteen biomedical applications problems were acted upon, three of which were new and potential solutions were found for 12 of these problems. Five of these potential solutions resulted in successful transfers of technology: (1) a technique for enhancing X ray photographs; (2) a temperature telemetry system for internal organs; (3) an enzyme electrode amplifier and telemetry system; (4) cardiac output measurement; and (5) a learning machine for mentally retarded children. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-36086 Louisana State Univ., Baton Rouge.
DONOR PROPERTIES OF TELLURIUM IN TRANSITIONAL METAL COMPLEXES
Eldrid Wayne Tilley (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17349

The donor properties of the heavier atoms of groups IVA, VA, and VIA of the periodic table toward transitional metal substrates have evoked considerable interest in recent years. Conspicuously lacking from such studies have been significant investigations of selenium and tellurium-donor properties, in contrast to numerous studies of sulfur-donor ligands. The apparent lack of interest in selenium and tellurium containing ligands may be attributed in part of the obnoxious character of many compounds of these elements. Nevertheless, comparative studies of donor properties of analogous ligands containing sulfur, selenium and tellurium are desirable.

Investigations of the donor properties of diphenyl ditelluride, C_6H_5-Te-Te-C_6H_5, and analogous sulfur and selenium compounds, toward π-cyclopentadienyl transitional metal substrates have been carried out, and a number of new organometallic compounds has been prepared. Dissert. Abstr.

N68-36090 Minnesota Univ., Minneapolis.
MOLECULAR STUDIES OF REVERSIBLE AND IRREVERSIBLE PHENOMENA IN SIMPLE FLUIDS
Kraemer Delanoy Luks (Ph.D. Thesis) 1967 220 p
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 67-17283

Several molecular theories are developed and applied to simple dense fluids. Comparisons with experiment are made whenever possible. The conformal solution theory of the heats of mixing of molten salts is generalized to binary mixture with common anions. The results are expressed as functions of the parametric differences of the pair, the parameters being those that characterize potential energy function common to the pair. The integral coefficients of the parametric differences are formally evaluated for the first time. Numerical evaluation of the integrals is prevented by a lack of pair correlation functions, although rough calculations support the validity of the theory. The Davis–Rice–Sengers liquid state theory for dense square-well fluids, a modification of the Rice–Allnatt theory of liquids, is used to predict the transport properties of liquid argon, krypton and xenon. Dissert. Abstr.

N68-36137# Mound Lab., Miamisburg, Ohio.
A REVIEW OF THE DISSOLUTION OF PLUTONIUM DIOXIDE, PART 2
W. S. Gilman 7 Aug. 1968 12 p refs
(MLM-1513, Pt. 2) CFSTI: HC $3.00/MF $0.65

Available dissolution data for plutonium dioxide were compiled together with a bibliography on the subject. The ease of solubility of PuO_2 in various media is dependent on the method of its preparation, the impurities present, and the temperature at which the PuO_2 was calcined or sintered. Author (NSA)

N68-36163# Mound Lab., Miamisburg, Ohio.
COMPLEMENTARY COLORIMETRIC APPROACH TO THE ANALYSIS OF CHEMICAL SYSTEMS. SUCCESSIVE FIRST ORDER REACTIONS IN FOUR DIMENSIONS
G. L. Silver 5 Jul. 1968 23 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1492) CFSTI: HC $3.00/MF $0.65

Complementary colorimetric techniques were extended to a chemical system containing five species. The number of components contributing to the data is determined using matrix rank analysis or by complementary colorimetric techniques. The concentration of each of the five species is determined through definition of the five-sided four-solid that contains the colorimetric or radiometric data. Techniques of analytic geometry are then applied to yield equations that relate absolute concentrations. The technique is applicable both to linear systems, where the total concentration of all species is constant, and to nonlinear systems, where the total concentration of all species need not remain constant during the course of the analysis. It can also be generalized for use with systems containing an unlimited number of species. Author (NSA)

N68-36165 Cornell Univ., Ithaca, N. Y.
LOW ENERGY ELECTRON DIFFRACTION STUDIES, ADSORPTION OF O_2, CO AND N_2 ON THE TUNGSTEN (112) FACE
Chuan Chung Chang (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-17232

Low Energy Electron Diffraction studies of gas adsorption on the (112) single crystal face of tungsten are reported. This surface is found to have the ideal geometry, and the crystal can be heated to about 2500°K without thermal faceting. Oxygen dissociatively adsorbs at room temperature and several species of adsorbed oxygen have been identified. Probable surface structures for all the observed oxygen patterns are presented. Carbon monoxide adsorbs as an immobile layer at room temperature and when the crystal is heated, α β_1 and β_2 flash off peaks are observed at 400, 1000, and 1200°K. Room temperature adsorption produces no ordered structure but heating orders the adsorbed molecules. Nitrogen adsorbs with an initial sticking probability of only 0.03 compared to 0.8 for oxygen and 0.9 for carbon monoxide. Nitrogen can be flashed off as β_1 and β_2 at 1200 and 1330°K. Dissert. Abstr.

N68-36173# Technische Hochschule Munchen (West Germany).
PREPARATION AND REACTIONS OF THE TRIFLUOROPHOSPHINE COMPLEXES OF NICKEL, PALLADIUM, AND PLATINUM [DARSTELLUNGS- UND REAKTIONWEISEN DER TRIFLUORPHOSPHIN-KOMPLEXE DES NICKELS, PALLADIUMS UND PLATINS]
Karl Baur (Ph.D. Thesis) 28 Jun. 1968 89 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Several new and efficient methods were found for the preparation of tetrakis (trifluorphosphine) nickel (0). The homolog tetrakisfluorphosphines of palladium(0) and platinum(0) were synthesized by several methods as clear, highly volatile liquids. In addition to the quantitative total synthesis with nickel and palladium powders under trifluorphosphine pressure, the formation yielded by the metal halogenides without addition of a reducing metal was significant; trifluorphosphine functioned as the reduction agent and as the complex ligand. The tetrahedric structure of the tetrakistrifluorphosphines was demonstrated by IR spectroscopy and NMR studies with F 19 and P 31 isotopes. Substitution reactions with carbon monoxide and donator compounds of elements of the 5th main group are possible with the trifluorphosphine complexes of nickel, palladium, and platinum. The gradation of the donator properties of phosphor ligands of the type PY_3 was demonstrated through the shift in P-F valence oscillations. During the reaction of nickel trifluorphosphine with barium hydroxide in tetrahydrofurane, only one F atom is exchanged against an OH group, resulting in the anionic complex $[Ni(PF_3)_3PF_2O^-]$; in the presence of strong alkylation agents, this complex will form the ester $Ni(PF_3)_3PF_2OR$. Transl. by K.W.

N68-36187# Harry Diamond Labs., Washington, D. C.
THE THERMAL REACTION BATTERY. PART 2: PREPARATION AND PYROLYSIS OF SOME AROMATIC HYDRAZONES AND HYDRAZIONIUM SALTS
Fred M. Dewey Jun. 1968 27 p refs
(HDL-TR-1398, Pt. 2; AD-673701)

Organic compounds that can be thermally degraded to yield permanently liquid solvents for ionizable salts for use in the proposed thermal reaction battery continue to receive attention. It was confirmed that benzaldehyde phenylhydrazone undergoes pyrolysis to give benzonitrile, and that acidic reagents accelerate the reaction. Benzaldehyde trimethylhydrazonium salts were found to undergo rapid cleavage at 230-240C, giving benzonitrile and a trimethylammonium salt as major products. Hence, the hydrazonium salts are promising candidates for use as electrolyte carriers. Author (TAB)

N68-36201# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
MOLYBDENUM (II) CLUSTER COMPOUNDS INVOLVING ALKOXY GROUPS

Piero L. Nannelli and B. Peter Block Jul. 1968 18 p refs
(Contract Nonr-2687(00))
(TR-57; AD-672562)

Molybdenum(II) halides readily react with alcoholic solutions of either sodium methoxide or ethoxide at room temperature to give crystalline coordination compounds of the type Na2((Mo6×8)(Or)6) in which the (Mo6×8) (4+) cluster behaves like a hexacoordinate coordination center, more vigorous treatment of molybdenum(II) chloride with sodium methoxide in methanol yields the crystalline compound Na2((Mo6(OCH3)8) (OCH3)6) in which both ligand and cluster chloride ions are replaced by methoxy groups. This compound appears to contain the cluster (Mo6(OCH3)8) (4+) analogous to the well known (Mo6×8) (4+) on the basis of magnetic properties, oxidation state of the molybdenum, proton magnetic resonance, conductivity, molecular weight, and infrared spectra. Author (TAB)

N68-36202# Michigan State Univ., East Lansing. Dept. of Chemistry.
ANALYSIS OF THE PURE ROTATIONAL ABSORPTION SPECTRA OF HYDROGEN SULFIDE AND DEUTERIUM SULFIDE
R. E. Miller, G. E. Leroi, and T. M. Hard (MIT) Jul. 1968 26 p refs Submitted for publication
(Contract N00014-68-A-0109)
(TR-5(30); AD-672806)

The far infrared spectra of H2S, D2S and H2S-D2S mixtures at low pressures were obtained under high resolution. The analysis of H2S in the pure rotation region has shown that the rotational and distortion parameters established from the vibration-rotation measurements by Edwards are appropriate to account for the observed spectrum. For D2S, comparison of the observed and theoretical spectra suggests that the previously established parameters should be modified slightly. New values for the rotational and distortion parameters for D2S have been derived from far-infrared and microwave information by the combination-difference method. Author (TAB)

N68-36203# Illinois Univ., Urbana. Noyes Chemical Lab.
NMR STUDY OF $BaFPO_3$: P^{31} AND F^{19} CHEMICAL-SHIFT ANISOTROPIES AND THE ABSOLUTE SIGN OF THE F-P COUPLING CONSTANT
P. L. Vanderhart, H. S. Gutowsky, and T. C. Farrar (Natl. Bur. Std., Washington, D. C.) 3 Jul. 1968 33 p refs Submitted for publication
(Contract N00014-66-C-0010)
(TR-18; AD-672807)

The FPO3(=) ion in polycrystalline BaFPO3 was investigated from the point of view that it is a very slightly distorted, axially symmetric two-spin system. NMR line shape analysis for the 31P spectrum as a function of magnetic field yielded the following information: (1) the chemical shift anisotropy is -145 plus or minus 20 ppm for phosphorus; (2) the absolute sign of the F-P indirect dipolar coupling constant is negative; (3) the internuclear F-P distance is 1.63 plus or minus 0.035A. Investigation of the 19F spectra was carried out through a second moment analysis as a function of magnetic field. It was found that the fluorine chemical-shift anisotropy is plus 182 plus or minus 22 ppm, where the sign is deduced from the sense of the line shape asymmetry. Furthermore, an estimate of the intermolecular dipolar contribution to the second moment was obtained by extrapolating the total second moment to low field and then subtracting the intermolecular dipolar contribution which is known from the 31P spectra. The intermolecular dipolar contribution is such that if BaFPO3 has a structure analogous to BaSO4, K2SO4, and K2FPO3, then there is a high degree of rotational disorder of the FPO3(=) ions in the crystal. Author (TAB)

N68-36204# Sandia Corp., Albuquerque, N. Mex.
PREPARATION AND CHARACTERIZATION OF ULTRAFINE CARBIDES, NITRIDES, AND METALS [HERSTELLUNG UND CHARAKTERISIERUNG VON ULTRAFEINEN KARBIDEN, NITRIDEN, UND METALLEN]
E. Neuenschwander [1968] 15 p refs Transl. into ENGLISH from J. Less-Common Metals (Netherlands), v. 11, 1966 p 365–375
(SC-T-68-1535) CFSTI: HC $3.00/MF $0.65

Chlorides of refractory metals were reacted in a jet of hydrogen of a mean temperature of 3000°C with methane to form carbides and with nitrogen to form nitrides. Furthermore, the jet of hydrogen was used to reduce the chlorides to the metals. Ultrafine products with particle sizes in the range 100–1000 Å were obtained. TaC, NbC, TiC, TaN, and W are given as examples and their properties are described. Author (NSA)

N68-36230# Texas Univ., Austin.
INFLUENCE OF SEDIMENTS ON THE TRANSPORT OF SOLUTES
C. S. Shih and Earnest F. Gloyna 13 May 1968 41 p refs Presented at the ASCE Environ. Conf., Chattanooga, Tenn.
(Contract AT(11-1)-490)
(ORO-490-12a; CONF-680516-1) CFSTI: HC $3.00/MF $0.65

A transport relationship which considers the sorption–desorption characteristics of a non-biodegradable solute was developed. The radionuclide, ^{85}Sr, was used to test the transport hypothesis under a variety of environmental conditions. Experiments included evaluation of the sorption of ^{85}Sr by sediments in both flowing and non-flowing aquatic systems. Author (NSA)

N68-36233# Miami Univ., Coral Gables, Fla. Dept. of Chemistry.
THE THERMAL DECOMPOSITION OF AMMONIUM PERCHLORATE: A LITERATURE REVIEW
A. G. Keenan and Robert F. Siegmund 1 Aug. 1968 51 p refs
(Contract Nonr-4008(07))
(Rept.-6; AD-673542)

The review includes the following topics: Stoichiometry of thermal decomposition; Stoichiometry of deflagration; Crystal structure and transformation; Sublimation; Low temperature reaction mechanisms (electron transfer, proton transfer, activation energy); High temperature reaction mechanisms; Effect of impurities, particle size, and lattice defects. TAB

N68-36238# Technische Hochschule Munchen (West Germany).
ON AZIDE-METAL COMPLEXES [UEBER AZIDO-METALLKOMPLEXE]
Peter Poellman (Ph.D. Thesis) 14 Jun. 1968 76 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

The preparation of homogeneous azidometallic complexes and phosphine-containing azidometallic compounds is described. By the reaction of alkali azide with metal salts or the corresponding halogeno complexes in aqueous or nonaqueous media, a number of azidometallate anions were obtained in the form of their tetrabutylammonium, tetraphenylphosphonium, tetraphenylarsonium or bis(triphenylphosphine)nitride salts. The reaction of lithium- or sodiumazide with the corresponding phosphine-containing chloro-complexes, or the reaction of silver azide with triphenylphosphine resulted in the formation of several neutral complexes. Magnetic measurements were performed on a number of azido complexes and other transition metal complexes to determine composition and structure. The highly explosive dimethyl gold azide $[(CH_3)_2AuN_3]_2$ was obtained from ethylendiamine-dimethyl gold iodide [(Au(CH3)2en)I] and silver azide. The reactions of the triphenylphosphine complexes $[P(C_6H_5)_3]_2Ir(CO)N_3$ and $[P(C_6H_5)_3]AuN_3$ with carbon dioxide were studied, and thermogravimetric analyses were made on diazido-bis(triphenylphosphine)-palladium(II). Transl. by K.W.

N68-36256# Bureau of Mines, Albany, Oreg.
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF FOUR CRYSTALLINE SODIUM-CALCIUM SILICATES
L. B. Pankratz Nov. 1968 12 p refs
(BM-RI-7201)

Heat contents were measured for Na_2CaSiO_4 and $Na_2Ca_2Si_2O_7$ between 298° and 1300° K, for $Na_2Ca_2Si_3O_9$ between 298° and 1500° K, and for $Na_4CaSi_3O_9$ between 298° and 1350° K. Copper-block drop calorimetry was employed. Reversible, first-order transitions were found for Na_2CaSiO_4 and $Na_2Ca_2Si_3O_9$. The transition for Na_2CaSiO_4 is at 830° K with a heat absorption of 160 cal/mole; that for $Na_2Ca_2Si_3O_9$ occurs at 750° K with a heat absorption of 1550 cal/mole. Results for the other two silicates showed no irregularities. A table of heat content and entropy increments above 298.15° K and heat content equations are included for use in thermodynamic calculations.
Author

N68-36297# AeroChem Research Labs., Inc., Princeton, N. J.
FORMATION OF ELECTRONICALLY EXCITED SPECIES IN NITROGEN ATOM/OXYGEN ATOM RECOMBINATION REACTIONS CATALYZED BY CARBON COMPOUNDS
Arthur Fontijn and Roy Ellison Jul. 1968 12 p refs Prepared for Purdue Univ.
(Contract N00014-67-A-0226; Proj. Squid)
(AC-7-PU; AD-673544)

Further evidence for the formation of excited species in N-atom/O-atom recombination reactions catalyzed by carbon compounds is obtained. Such formation of N2* and/or NO* was previously infered from the enhancement of the NO(+) (chemi-ion) formation rate upon carbon compound addition. The present paper discusses a similar enhancement of NO A(2)Sigma, NO B(2)Pi and O((1)S) formation rate, observed directly by the chemiluminescent light emission from these species.
Author (TAB)

N68-36313# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DETERMINATION OF VAPOR PRESSURES OF VARIOUS β-DIKETONE METAL CHELATES
Raymond A. Shulstad (M.S. Thesis) Jun. 1968 92 p refs
(GNE/PH/68-11; AD-673847)

The vapor pressures of various beta-diketone metal chelates were measured by utilizing a quartz spiral bourdon gauge as a nulling instrument and reading the pressures from an oil manometer. Determinations were made in the temperature range of 60 to 200C for the chromium and aluminum chelates of hexafluoroacetylacetone, trifluoroacetylacetone, and acetylacetone. Vapor pressure measurements were also obtained for yttrium dipivaloylmethanate in the temperature range of 130 to 250C. Heats of sublimation and vaporization were calculated from the Clausius-Clapeyron plots of the vapor pressure data.
Author (TAB)

N68-36314# Technische Hochschule Munchen (West Germany).
INVESTIGATION OF ELIMINATION REACTIONS IN β ACTIVATED SYSTEMS USING ISOTOPE EFFECTS [UNTERSUCHUNG VON ELIMINIERUNGSREAKTIONEN AN β AKTIVIERTEN SYSTEMEN MIT HILFE VON ISOTOPENEFFEKTEN]
Elmar Reinwald (Ph.D. Thesis) 7 May 1968 80 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

A quantum mechanical model is used to analyze the isotopic effect in β-elimination reactions where two atoms or atom groups bound to neighboring C atoms are split off under multiple bond formation. Isotope effect measurements on synthetic quaternary ammonium salts with tritium labeled β-positions indicate that the base absorbs a proton from the β C atom, a carbon anion is formed as intermediate product, and the rest of the leaving group splits from the C atom at speed that decides reaction velocity. If the first step is faster than the second, an equilibrium is formed. A proton exchange through the carbon anion was not observed.
Transl. by G.G.

N68-36315# Technische Hochschule Munchen (West Germany).
NATURAL β SUBSTITUTION METHODS FOR SYNTHESIS OF DIPYRROMETHANES [WEGE ZUR DARSTELLUNG VON PROPENTDYOPENTEN MIT NATUERLICHER β-SUBSTITUTION]
Norbert W. Dieter (Ph.D. Thesis) 9 May 1968 65 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Pressureless reduction and decarbolyzation of 4 methyl 3 acetyl 2 carboxypyrrole gives 4 methyl ethyl pyrrole for subsequent synthesis of dipyrromethene through formylation. Halogen-free alkaline formylpyrroles react with pyrrolinone (2) to form the corresponding oxo-dipyrromethenes; halogen containing formylpyrroles require N-methylation of the aldehyde for successful synthesis. Nuclear magnetic resonance spectra of various N-methylation agent adducts are discussed.
Transl. by G.G.

N68-36345# Los Alamos Scientific Lab., N. Mex.
CARBON DIFFUSION IN THE CARBIDES OF URANIUM
T. C. Wallace, W. G. Witteman, C. L. Radosevich, and M. G. Bowman 1968 45 p refs Presented at the 6th Intern. Plansee Sem. on High Temp. Mater., Fundamental, and Develop., Reutte, Austria
(Contract W-7405-ENG-36)
(LA-DC-8840; CONF-680603-2) CFSTI: HC $3.00/MF $0.65

The chemical diffusion coefficient of carbon in UC_y (face centered cubic, B1 structure type) has been determined as a function of composition and temperature. The heat of chemical diffusion has a maximum value of 142.5 ± 21.3 kcal/mole at approximately $UC_{1.3}$. U_2C_3 (body centered cubic, space group I43d) and α-UC_2 (body centered tetragonal space group I4/mmm) layer growths were studied over the temperature ranges 1185 to 1780° and 1525 to 1780°C, respectively. Carbon self diffusion coefficients were calculated from the experimental data and known thermodynamic data. From thermal diffusion experiments it is shown that the apparent heat of transport is positive for the single and two phase regions studied in the composition range $UC_{1.0}$ to $UC_{1.85}$.
Author (NSA)

N68-36363# Gulf General Atomic, San Diego, Calif.
CHEMICAL REACTIONS ON CLEAN SURFACES, USING MODULATED ATOMIC BEAM TECHNIQUES Final Technical Report, 1 Apr. 1965-31 Mar. 1968
Robert L. Palmer, Howard Saltsburg, and Joe N. Smith, Jr.
25 Apr. 1968 38 p refs (Contract AF 49(638)-1559)
(GA-8642; AFOSR-68-1757; AD-673510)

The hydrogen-deuterium exchange reaction on nickel has been studied using modulated molecular beam techniques. When coupled with a surface preparation technique that allows one to grow clean single crystals during the experiment, the molecular beam techniques permit one to show that the scattering of all the isotopic molecular hydrogenic species is specularly directed, while the product of the chemical reaction is scattered according to a modified cos Tr law. The proposal to use varying rates of continuous deposition of metal to control the surface concentrations of the adsorbed species was shown to be inapplicable to the H2-D2 exchange, as the measured background gas pressure dependence was unaffected by this deposition. This pressure dependence was also shown to vary with background gas pressure. From the

scattering data (at the higher pressure) it appears that both the reactants must be adsorbed prior to the formation of the product HD. Author (TAB)

N68-36367# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINMENT OF ARTIFICIAL DIASPORE (HYDROUS ALUMINUM OXIDE) [O POLUCHENII ISKUSSTVENNOGO DIASPORA]
N. K. Druzhinina 8 Sep. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 88, no. 1, 1953 p 133–134
(FTD-HT-67-464; AD-673842)

The obtainment of artificial diaspore (hydrous aluminum oxide) was accomplished in an alkali and aqueous medium with and without the presence of a primer. The experiments were realized in autoclave bombs from stainless steel periodically heated in an air thermostat. Exposure at such a temperature was calculated summarily. As initial materials, solutions of chemically pure alkali of various concentrations and artificial boehmite were used. Natural diaspore was used for the primer, and those experiments introducing the primer produced optical characteristics corresponding to that of the natural diaspore. However, those experiments carried out without the introduction of a primer at 315 and 350C gave no positive results. Author (TAB)

N68-36381# Weapons Research Establishment, Salisbury (Australia).
A NUMERICAL SOLUTION FOR DIFFUSING, REACTING CHEMICAL RELEASES, WITH APPLICATIONS
K. H. Lloyd Jul. 1968 38 p refs
(WRE-TN-HSA-129) CFSTI: HC$3.00/MF$0.65

A Fortran program is described which solves numerically the non-linear equations that describe the diffusion and chemical reactions of a spherically symmetric release of containment into the upper atmosphere. The program was written in the hope that, by modelling the cloud behaviour, unknown parameters, such as rate constants for chemical reactions, could be determined for actual releases. The model assumes that the diffusion is molecular, that the cloud size is greater than the mean free path of the molecules, and that all reactions are bimolecular. A release of NO_2 at 110 km altitude is examined in detail and the unknown parameters varied to obtain a best fit to the photographic observations. The results differ from those calculated without taking account of the interactions between diffusion and chemical reaction. Author

N68-36388# Technische Hochschule Munchen (West Germany).
PHYSICAL TESTING OF THE 30 amp ARC WITH REGARD TO ITS UTILIZATION IN QUANTITATIVE SPECTRUM ANALYSIS [PHYSIKALISCHE UNTERSUCHUNG AM 30 AMP BOGEN IM HINBLICK AUF SEINE VERWENDBARKEIT IN DER QUANTITATIVEN SPEKTRALANALYSE]
Horst Jaeger (Ph.D. Thesis) 18 Jan. 1968 61 p refs In GERMAN
CFSTI: HC$3.00/MF$0.65

Described is a quantitative spectrochemical analysis by argon plasmas. Chemical substances introduced into the plasma arc are measured photographically and the distribution of the various elements in the plasma cross section is used to correct emission coefficients. A definite arc temperature dependence on arc current density and discharge carrier is established through temperature measurements on potassium, aluminum, magnesium, and silicon elements diluted by argon. It is shown that arc temperature is proportional to the electron ionization potential of the added elements. Data of metal-argon plasmas can be applied to multiple component systems, especially to the spectrochemical by important Ar-O-C plasms. G.G.

N68-36392# Leicester Univ. (England). Dept. of Chemistry.
METALS IN NON-METALLIC SOLVENTS Final Report
M. C. R. Symons Jan. 1968 41 p refs
(Grant AF-EOAR-80-64)
(AFOSR-68-0842; AD-673502)

The electron spin resonance absorption of the solvated sodium atom in ammonia-ethylamine mixtures is reported. The atomic characters of the other solvated alkali atoms are compared with that of sodium. The dependence of line-width upon alkali metal nuclear spin configuration is interpreted in terms of an equilibrium between two species, one having a very small hyperfine coupling and the other having a coupling close to the atomic value. Concentration-broadening of the central singlet is interpreted in terms of interactions with the diamagnetic species which account for the majority of the dissolved metal. Author (TAB)

N68-36398# Fulmer Research Inst., Ltd., Stoke Poges (England).
THE HEATS OF FORMATION OF THE CARBIDES OF ALUMINUM AND BERYLLIUM
R. O. G. Blachnik, P. Gross, and C. Hayman 3 Jul. 1968 28 p refs
(Contract AF 61(052)-863)
(R.163/SR-5; AFOSR-68-1795; SR-5; AD-673897)

The heats of formation of the carbides of aluminium and beryllium were determined by dissolving them and by comparing their heats of solution in hydrochloric acid at 110C with those of the constituent metals. The experiments were carried out in closed glass vessels. Author (TAB)

N68-36406# Stanford Univ., Calif. Dept. of Computer Science.
HEURISTIC DENDRAL: A PROGRAM FOR GENERATING EXPLANATORY HYPOTHESES IN ORGANIC CHEMISTRY
Bruce Buchanan and Georgia Sutherland 26 Jul. 1968 80 p refs
(Contract ARPA SD-183)
(AI-MEMO-62; AD-673382)

A computer program has been written which can formulate hypotheses from a given set of scientific data. The data consist of the mass spectrum and the empirical formula of an organic chemical compound. The hypotheses which are produced describe molecular structures which are plausible explanations of the data. The hypotheses are generated systematically within the programs theory of chemical stability and within limiting constraints which are inferred from the data by heuristic rules. The program excludes hypotheses inconsistent with the data and lists its candidate explanatory hypotheses in order of decreasing plausibility. The computer program is heuristic in that it searches for plausible hypotheses in a small subset of the total hypothesis space according to heuristic rules learned from chemists. Author (TAB)

N68-36437# Naval Research Lab., Washington, D. C.
EFFECT OF ADSORBED WATER ON THE CRITICAL SURFACE TENSION OF WETTING ON METAL SURFACES
Marianne K. Bernett and W. A. Zisman 26 Jun. 1968 15 p refs
(NRL-6727; AD-673396)

Contact angles of a variety of pure polar and nonpolar, nonhydrophilic liquids, covering a wide range of surface tensions, were measured at 20C on clean, smooth surfaces of 14 metals and one metal oxide. At low RH of only 0.6% and high RH of 95%, each of these high-energy, solid surfaces was converted to one of much lower critical surface tension of wetting g by the physical adsorption of a thin film of water. The formation of only a fraction of a monolayer at 0.6% RH decreased g to about 45 dynes/cm for each metal surface; additional water adsorption at 95% RH to form a more condensed film further lowered g to a

common value of 38 dynes/cm. Since g values were nearly identical for each surface at each extreme of the RH, the surface energy of these hydrophilic solids must be independent of the constitution of the underlying solid substrate and dependent only on the surface concentration of the adsorbed water. These results were the same as previously obtained for glass surfaces. It is therefore proposed that the surface energy of any clean, smooth, high-energy, hydrophilic surface, whether glass, metal or metal oxide, after exposure to a humid atmosphere depends on the surface concentration of water adsorbed on the surface and that the chemical nature of the underlying hydrophilic substrate has little other effect on wetting and spreading properties. Author (TAB)

N68-36477# Pennsylvania State Univ., University Park. Materials Research Lab.
STRUCTURAL CHARACTERIZATION OF THIN ALUMINUM OXIDE–HYDROXIDE LAYERS BY THE ALUMINUM AND OXYGEN X-RAY EMISSION BANDS
G. A. Savanick, P. Gigl, and E. W. White 1 Aug. 1968 12 p refs
(Contract N00014-67-A-0385)
(TR-1; AD-673299)

A new technique is outlined for the characterization of thin films of crystalline and amorphous aluminum oxides, aluminum oxyhydroxides and aluminum hydroxides. Shifts in Al K-beta and OK-alpha x-ray emission lines of known examples of these compounds are presented and are used to identify unknown Al–O–OH compounds. Author (TAB)

N68-36502# Case Western Reserve Univ., Cleveland, Ohio.
NUCLEATION OF DIMETHYLGLYOXIMES Final Report
Stephen Thompson and Alan G. Walton 1 Sep. 1967 62 p refs
(Contract AT(11-1)-582)
(COO-582-14) CFSTI: HC $3.00/MF $0.65

Processes of nucleation are discussed. The nucleation and growth of nickel dimethylglyoximate, nickel cyclohexanedioximate, and palladium dimethylglyoximate were studied. Interfacial energies were calculated. Experimental details of the system utilized to produce and observe precipitation of nickel dimethylglyoximate is very small droplets are described. Crystal structures of nickel and palladium derivatives of a whole series of dialkyldioximes were studied by electron microscopy. NSA

N68-36527# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALKYLATION OF FERROCENE BY OLEFINS IN THE PRESENCE OF COMPOUNDS OF BORON FLUORIDE AND ALUMINUM CHLORIDE [ALKILIROVANIE FERROTSENA OLEFINAMI PRISUTSTVII SOEDINENII FTORISTOGO BORA I KHLORISTOGO ALYUMINIYA]
Ya. M. Paushkin, T. P. Vishnyakova, T. A. Sokolinskaya, K. I. Zimina, and G. G. Kotova 15 Sep. 1967 11 p refs Transl. into ENGLISH from Neftekhim. (Moscow), v. 3, no. 2, 1963 p 280–284
(FTD-HT-67-290; AD-673450)

The possibility of using boron fluoride compounds as catalysts in the olefin alkylation of ferrocene was investigated. It was established that when such catalysts are used, a considerable increase is obtained in the yield of ferrocene monoalkyl derivatives. For the first time, mono- and diisooctylferrocenes were prepared by reactions of direct olefin alkylation of ferrocene. Author (TAB)

N68-36585*# Monsanto Research Corp., Dayton, Ohio.
SILVER-ZINC BATTERY SEPARATOR MATERIAL DEVELOPMENT Final Report, 1 Jul. 1967–10 Jun. 1968
I. O. Salyer, E. V. Kirkland, and P. H. Wilken Jul. 1968 84 p Prepared for JPL
(Contracts NAS7-100; JPL-951966)
(NASA-CR-97226) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A project has been completed for the development and preparation of ethylene/acrylic acid membranes for application as separators in heat sterilizable silver oxide zinc secondary batteries. The membranes were made from a precursor copolymer (ethylene/methyl acrylate) by pressing into film, vulcanizing and hydrolyzing. Precursor copolymer was made by copolymerizing ethylene and methyl acrylate at ultra-high pressure. Membranes of ethylene/acrylic acid (or potassium salt) have been made that are stable in strong caustic during sterilization (140°C, 40% KOH, 60 hours), have low silver and zinc migration (Ag^{110} and Zn^{65} diffusion comparable to acrylic acid grafted on polyethylene), have satisfactory tensile strength for normal handling (500–1700 psi) and satisfactory elongation (120–330%). The acid form of the membranes are stronger and less hygroscopic than the salt form. Author

N68-36586*# Idaho State Univ., Pocatello. Chemistry Dept.
INVESTIGATION OF ELECTRODE MATERIALS FOR ALKALINE BATTERIES
G. Myron Arcand 25 Aug. 1968 53 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952265)
(NASA-CR-97223; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Greatest reduction of Ag(I) from a 10 VF KOH solution with Ag_2O occurs within the first 24 hours with little subsequent change. Chronopotentiograms, at 147 mA/cm², of zinc plates upon which silver has been deposited show transition times of 24 to 50 seconds as compared with 69 seconds for untreated plates. The results suggest that silver is deposited first as a strongly adherent layer followed by weakly held layers. AgO decomposes rapidly at first at 160° and then only slowly over a period of several hours. Decomposition of Ag_2O is considerable at 290°, but is insignificant below that temperature. Rough calculations show the activation energy for the thermal decomposition of AgO to be 26.2 kcal/mole and that of Ag_2O to be 43 kcal/mole. Amalgam electrodes with lithium, sodium, potassium, magnesium, calcium, barium, aluminum, copper, lead, zinc, and cadmium as active metals have been considered. The zinc-amalgam electrode gives good performance at high current densities; its open circuit potential is about −1.4 V *vs* Hg/HgO. The potassium-amalgam electrode also shows good discharge behavior; its open circuit potential is about −1.8 V *vs* Hg/HgO. The cadmium-amalgam electrode is poorly defined and actually may be a potassium-amalgam electrode. Author

N68-36596* New York Univ., N. Y. Dept. of Chemical Engineering.
INVESTIGATION OF THE CHEMICAL KINETICS OF AN ADVANCED HIGH ENERGY PROPELLANT SYSTEM Quarterly Progress Report, 1 Jun.–1 Sep. 1968
Leonard Dauerman, George Koehler, Asim B. Ray, and George E. Salser 1 Sep. 1968 18 p
(Contract NASr-183)
(NASA-CR-97203; QPR-21) CFSTI: $3.00 CSCL 07D

Kinetics of systems related to the OF_2/B_2H_6 propellant are being investigated. Among these are the kinetics of the thermal decomposition of OF_2, F_2, and B_2H_6, respectively, and the kinetics of the reaction between hydrogen and fluorine. Another program is commencing, in which the kinetics of the low temperature solid phase kinetics of the reaction between hydrazine and nitrogen tetroxide is to be investigated. This latter system is of interest because of reported engine difficulties in space. Author

N68-36635# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
NUCLEAR CHEMISTRY RESEARCH Technical Progress Report, 15 Dec. 1966–15 Dec. 1967
Nathan Sugarman and Anthony Turkevich 15 Dec. 1967 8 p
(Contract AT(11-1)-1167)
(COO-1167-3) CFSTI: HC $3.00/MF $0.65

Research progress is reported on: radionuclide production cross sections in Cu with protons at 90 to 440 MeV, radiochemical analysis of freshly fallen meteorites, meson spallation of Cu, recoil properties of isobaric nuclides, recoil studies of isomeric nuclides, evidence of a (p,pα) cascade reaction, and activation analysis for heavy elements in meteorites. NSA

N68-36675*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF INSTRUMENTATION FOR AIRBORNE COLLECTION OF ATMOSPHERIC ORGANIC CHEMICALS Final Report
Leonard A. Cavanagh Sep. 1968 64 p refs
(Contract NAS2-4511; SRI Proj. PRU-6856)
(NASA-CR-73253) CFSTI: HC $3.00/MF $0.65 CSCL 07A

A program designed to evaluate and exploit airborne organic detection as a tool for determining and classifying planetary biological activity is discussed. Measurements of the concentration of airborne emanations above regional flora may establish relationships that would permit characterization of flora by airborne sensing instrumentation. Techniques for airborne detection of trace organic concentrations were developed and field tested. A flight airborne sampling system was designed. Part of the design of the sampling system is a concentration procedure that makes use of the ability of gas chromatographic column packing material to selectively retain or trap organics while permitting the permanent gases of the terrain atmosphere to pass through the concentration trap. Sufficient material can be isolated and retained in the system to permit subsequent analysis. The organics of interest range from methane and other C_1 materials through the C_{10} terpene class of compounds. Author

N68-36697# Sandia Corp., Albuquerque, N. Mex.
MIXTURES OF CHEMICALLY REACTING INVISCID FLUIDS
J. Wiese Dec. 1967 32 p refs
(Contract AF(29-1)-789)
(SC-RR-67-859) CFSTI: HC $3.00/MF $0.65

A theory of mixtures of chemically reacting inviscid fluids is presented. The effects of viscosity, heat conduction, and diffusion are omitted for simplicity. A section on reaction kinetics is included. Constitutive equations are presented and restricted by the second law of thermodynamics. To illustrate the theory a mixture of chemically reacting perfect gases was analyzed. A procedure for solving the equations of the theory by numerical methods is outlined. Author (NSA)

N68-36704# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REACTION OF ETHYLENE GLYCOL MONOALKYL ETHERS WITH PHOSPHORUS PENTASULFIDE [VZAIMODEISTVIE MONOALKILOVYKH EFIROV ETILENGLIKOLYA S PYATISERNISTYM FOSFOROM]
A. M. Kuliev, Z. A. Alizade, and A. B. Aliev 18 Aug. 1967 8 p refs Transl. into ENGLISH from Azerb. Khim. Zh. (Azerbaidzhan), no. 6, 1965 p 10–13
(FTD-HT-67-76; AD-673686)

A study as made of the reactions of ethylene glycol monoalkyl ethers with phosphorus pentasulfide in order to develop new antioxidant additives for lubricating oils. The following compounds were thus prepared: O,O-di(beta-methoxyethyl)dithiophosphate, O,O-di(beta-ethoxyethyl)dithiophosphate, O,O-di(beta-propoxyethyl)dithiophosphate, O,O-di(beta-butoxyethyl)dithiophosphate, and O,O-di(beta-pentoxyethyl)dithiophosphate. The structure of these compounds was identified by converting these compounds to their ammonium salts and analyzing the latter. The physicochemical constants of both groups of compounds are tabulated. Author (TAB)

N68-36734# Florida State Univ., Tallahassee. Dept. of Chemistry.
STRUCTURAL STUDIES OF METAL COORDINATION COMPOUNDS Progress Report, 1 Oct. 1966–1 Oct. 1967
James V. Quagliano 15 Nov. 1967 14 p ref
(Contract AT(40-1)-2503)
(ORO-2503-8) CFSTI: HC $3.00/MF $0.65

Research on donor properties of positively charged ligands toward metal ions is summarized. Topics covered include: structural studies of ML^+X_3 complexes; five-coordinated Ni(II), a d^8 system, in C_{3v} symmetry; and complexes of cyclic tertiary amines. NSA

N68-36747 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
STRUCTURAL INVESTIGATIONS ON SOME OXIDES AND OTHER CHALCOGENIDES AT NORMAL AND VERY HIGH PRESSURES
C. J. M. Rooymans 1968 143 p refs *Its* Res. Rept. suppl. no. 5

A survey is given on the behavior of some groups of inorganic compounds, the oxides and chalcogenides, at very high pressures. Attention is given to constructions for X-ray-diffraction work with diamonds in the opposed-anvil arrangement. The thermodynamic and kinetic aspects of the reactions under very-high-pressure conditions are discussed. The crystallographic aspects of phase transitions are treated in a discussion on the change in the coordination number and the interatomic distances. Experimental and calculated values of the latent heat of transformation are compared. The behavior of the AX compounds under pressure is surveyed (X means O, S, Se and Te). Attention is given to high-pressure transitions in the cadmium and mercury compounds, in PbO, and in some rare-earth tellurides. The ABX_2 compounds are dealt with regarding the A_2X_3 compounds, the polymorphic behavior of In_2S_3, Fe_2O_3 and the rare-earth sesquioxides is discussed. The ilmenite-to-perovskite transition in $CdTiO_3$ and $CdSnO_3$ is treated. The AB_2X_4 compounds are reviewed, the pressure-induced phase transitions from the phenacite and olivine structure to the spinel structure are discussed. The new high-pressure results are reported in the context of all high-pressure activities in this field. Author

N68-36751# Los Alamos Scientific Lab., N. Mex.
A BIBLIOGRAPHY ON NUCLEAR MAGNETIC RESONANCE OF INORGANIC FLUORIDES
Jean Furnish, comp. 19 Feb. 1967 20 p refs
(Contract W-7405-ENG-36)
(LA-3871-MS) CFSTI: HC $3.00/MF $0.65

Three hundred and forty-six references from Chemical Abstracts, Volume 51 through 65, are presented. Inorganic fluorides alone, in solvents of any sort, and in complexes with organic and inorganic molecules are included. All references were indexed under "nuclear magnetic resonance" in Chemical Abstracts. Entries are arranged by year and then alphabetically by author's name. NSA

N68-36757# Atlantic Richfield Hanford Co., Richland, Wash.
DETERMINATION OF AMERICIUM WITH DI-N-BUTYL-N-BUTYLPHOSPHONATE
R. C. Kerns 5 Sep. 1967 28 p refs
(Contract AT(45-1)-2130)
(ARH-SA-1) CFSTI: HC $3.00/MF $0.65

A method is described for the determination of ^{241}Am in plutonium by solvent extraction using di-n-butyl-n-butylphosphonate and alpha counting. The greatest decontamination and the best recovery of Am occurred at 12 M HNO_3, the decontamination factor being greater than 10^4. In addition, E o/a (concentration in organic phase/concentration in aqueous phase) for Am at this acid concentration is less than 10^{-2}. These circumstances will permit the determination of very small quantities of Am in large excesses of Pu. Advantages and disadvantages of the method are discussed. NSA

N68-36763# Los Alamos Scientific Lab., N. Mex.
VARIABILITY IN THE STANDARDIZATION OF CERIC SULFATE SOLUTION FOR THE TITRATION OF PLUTONIUM
Glenn R. Waterbury, Dale C. Croley, and Charles F. Metz 9 Feb. 1968 8 p refs
(Contract W-7405-ENG-36)
(LA-3841) CFSTI: HC $3.00/MF $0.65

The titer for a ceric sulfate solution was 0.2% lower using sodium oxalate as a standard than when using either arsenic trioxide or plutonium metal standards. Difficulty in standardizing ceric sulfate solutions was experienced infrequently in the past and seemed to be associated with a very few lots of ceric sulfate reagent solution. The differences in titers emphasized the fact that the standard material should be similar to the samples to be analyzed. The potential user of ceric sulfate should be alerted to this possible, though rare, error in standardization. Author (NSA)

N68-36803# California Univ., Berkeley. Lawrence Radiation Lab.
THE SOLUTION ABSORPTION SPECTRUM OF TRIVALENT BERKELIUM AND THE CRYSTALLOGRAPHY OF BERKELIUM DIOXIDE, SESQUIOXIDE, TRICHLORIDE, OXYCHLORIDE, AND TRIFLUORIDE
Joseph Richard Peterson (Ph.D. Thesis) Oct. 1967 102 p refs
(Contract W-7405-eng-48)
(UCRL-17875) CFSTI: HC $3.00/MF $0.65

The physical and chemical properties of berkelium and its compounds are being studied. The procedures used to purify the ^{249}Bk solution are discussed in detail, as are the analytical techniques used to evaluate the purity of the Bk sample following each purification cycle. Repeated purifications were necessary to maintain the Bk samples in a state of high purity, since ^{249}Bk decays to ^{249}Cf at the rate of ≈0.2% per day. The experimental techniques used to study the Bk^{3+} solution absorption spectrum are discussed. The composite results of the observed spectra yielded 16 Bk^{3+} absorption peaks in the wavelength region 320 to 700 mμ. The two most intense peaks observed were at 418 and 474 mμ. The experimentally determined, electronic energy levels of Bk^{3+} were compared with theoretically derived values; however, no attempt to fit the observed data to the theoretical energy level scheme was made. Author (NSA)

N68-36807# Technischehochschule Munchen (West Germany).
DIINDOLYLMETHANE, DIINDOLYLMETHENE AND SIMILAR COMBINATION [DIINDOLYLMETHANE, METHENE UND AEHNLICHE VERBINDUNGEN]
Dieter Wolkenstein (Ph.D. Thesis) [1968] 85 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Variously bridge-bonded diindolylmethanes with substituted and unsubstituted methylene bridges were obtained from glyoxyl acid and indole derivatives. It was possible to prepare new indolaldehyde derivatives by applying the Vilsmeier synthesis to indole derivatives. Condenstation of these products with indoles led to classical β,β-diindolylmethenes and the new α,β-diindolylmethenes, which have a monomeric structure and are identical with the oxidation product derived from the corresponding methane. Another new class, the variously bridge-bonded oxo-diindolylmethenes oxidized on the pyrrole nucleus, was also isolated. Good yields of methane-like products were obtained during the condensation of formylindole derivatives with other CH-acid compounds. Structures were verified by IR and paramagnetic resonance spectral analyses. Transl. by K.W.

N68-36810# Brookhaven National Lab., Upton, N. Y.
RADIATION INDUCED DECOMPOSITION OF METHYL IODIDE IN AIR
I. N. Tang and A. W. Castleman, Jr. Jan. 1968 7 p refs Presented at the 14th Ann. Am. Nucl. Soc. Meeting, Toronto, Jun. 1968 Sponsored by AEC
(BNL-12219; CONF-680601-2)

Results of a study on the ^{60}Co γ-induced decomposition of iodomethane in air are presented. Experiments were performed at ambient temperature with mixtures of air and CH_3I of initial concentrations ranging from 1.1×10^{-8} to 2.4×10^{-6}M at dose rates varying from 4.81×10^{14} to 1.84×10^{16} eV/g-sec. The decomposition of CH_3I in the initial concentration range of 10^{-8} to 10^{-6}M was pseudo-first order since a plot of the data on semilogarithmic coordinates yielded a straight line. The total absorbed dose at 50% decomposition was 7.3×10^{18} eV/g air. Methyl nitrate and methyl nitrite were the major radiolysis products observed. A mechanism to account for the experimental observations is proposed. NSA

N68-36820# Sandia Corp., Albuquerque, N. Mex.
ANALYTICAL PROCEDURES FOR THE ENVIRONMENTAL HEALTH LABORATORY
Lial W. Brewer, ed. Feb. 1968 153 p refs Sponsored by AEC
(SC-M-67-3044) CFSTI: HC $3.00/MF $0.65

Methods are described for various determinations including: acetone acid and alkali contaminants, benzene, toluene, other aromatics, Be, chromic acid, chromates, dichromates, formaldehyde, methanol, NO_2, oil mist, ozone, phosgene, SiO_2, SO_2, and Zn in air; actinides, arsenic, enriched U, F_2, Hg, ^{210}Po, and trichloroacetic acid in urine; Be in air and on swipes; Cd and Tl in air and urine; ^{137}Cs and gross beta activity in soil, urine, vegetation, and water; Cr in urine and water; composition of organic solvents; free silica; Pb in air, urine, and on swipes; ^{24}Na in air, blood, urine, and water; ^{90}Sr in soil, vegetation, and water; total I in oil; total U on fallout trays and in soil, urine and water; and T in urine, water, and on swipes. General procedures are also described for spectrographic analysis, atomic absorption analysis, and breath analysis using the gas chromatograph. NSA

N68-36822# Oak Ridge National Lab., Tenn.
ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING 31 OCTOBER 1967
Helen P. Raaen, ed. Jan. 1968 194 p refs
(Contract W-7405-eng-26)
(ORNL-4196) CFSTI: HC $3.00/MF $0.65

Research progress is reported in 12 sections: analytical instrumentation, effects of radiation on analytical methods, analytical chemistry for reactor projects, special research and development activities, analytical biochemistry, X-ray and optical spectrochemistry, mass spectrometry, optical and electron microscopy, nuclear and radiochemical analyses, inorganic preparations, and organic preparations. Service analyses, work on the ORNL Master Analytical Manual, activities related to educational institutions, and extralaboratory professional activities are discussed. NSA

N68-36829 Technische Hochschule Munchen (West Germany).
RESEARCH ON THE CHEMICAL MATURATION OF PHOTOGRAPHIC SILVER BROMIDE EMULSIONS [UNTERSUCHUNGEN UEBER DIECHEMISCHE REIFUNG PHOTOGRAPHISCHER BROMSILBEREMULSIONEN]

Wilfried Bahnmueller (Ph.D. Thesis) [1968] 88 p refs In GERMAN Supported in part by Bavarian Min. of Com and Econ.
CFSTI: $3.00

Sodium thiosulfate and iridium in the form of hexachloro complexes were studied for their sensitizing functions in photographic emulsions. The spectral sensitization of sodium thiosulfate by sulfur maturation and related analytical problems were investigated. Iridium was found to act as a sensitizer in photographic silver bromide emulsions as follows: (1) iridium (III) as a trap for defect electrons; and (2) iridium (IV) as a trap for electrons. These two cases can be distinguished by the distribution of the latent image. The activity of the iridium inside the grain, on the grain surface, and in the crystal can be demonstrated by the radioactive tracer method. Transl. by K.W.

N68-36848# Michigan State Univ., East Lansing. Dept. of Physics.
STUDY OF INTERACTIONS BETWEEN f-SHELL TRANSITION IONS IN NON-METALLIC CRYSTALS Annual Technical Progress Report, 1 Oct. 1967–1 Jun. 1968
15 Jun. 1968 15 p refs
(Contract AT(11-1)-1533)
(COO-1533-7) CFSTI: HC $3.00/MF $0.65

Progress on a project concerned with the interactions between ions in lanthanide and actinide salts, especially those arising from exchange and leading to magnetic ordered states, is reported briefly. Some illustrative data on local fields at chlorine nuclei in $GdCl_3$ are included. Cell parameters for compounds known to be isomorphic to YCl_3 are tabulated. Results of a search for quadrupole resonances in rare earth trichlorides and mixed rare earth–alkali metal halide compounds are shown briefly. NSA

N68-36853# California Univ., Berkeley. Lawrence Radiation Lab.
RADIO FREQUENCY STARK SPECTRA OF RbF, RbCl, CsF, CsCl, AND NaI
Francis John Lovas (Ph.D. Thesis) Nov. 1967 87 p refs
(Contract W-7405-ENG-48)
(UCRL-17909) CFSTI: HC $3.00/MF $0.65

The molecular beam electric resonance method was used to measure the radio-frequency Stark spectra of ^{85}RbF, ^{87}RbF, $^{85}Rb^{35}Cl$, CsF, $Cs^{35}Cl$, and NaI. Weak field measurements were made on RbF to obtain accurate hyperfine-structure constants. Intermediate- to strong-field measurements were made on all the above molecules to obtain dipole-moment values for the three lowest vibrational states of the $J = 1$ or 2 rotational state. Work on a polarizable ion model of the alkali metal halides, which computes dipole moments, the molecular dissociation energy, and the second coefficient of the Dunham expansion of the potential energy, is also presented. Good agreement with experimental values is obtained. Author (NSA)

N68-36857# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
ISOTOPIC EXCHANGE OF DEUTERIUM BETWEEN HYDROGEN AND WATER VAPOR ON ALUMINA PROMOTED NICKEL
Al. Olariu and P. Marginean 11 Sep. 1967 10 p refs
(IFA-IS-48)

Measurement of nickel surface area, catalytic activity, and total surface area of alumina-promoted nickel was carried out. As a test reaction of the catalytic activity the isotopic exchange of deuterium between hydrogen and water vapor was used. The experimental results were compared with those previously obtained for chromia-promoted nickel. The better dispersed alumina-promoted nickel was less active than chromia-promoted nickel. The role of promoter nature is discussed. Author (NSA)

N68-36860# Arkansas Univ., Fayetteville. Dept. of Chemistry.
TRACER AND ISOTOPE EFFECT STUDIES IN ORGANIC CHEMISTRY Annual Progress Report
Arthur Fry 1 Feb. 1968 23 p refs
(Contract AT(40-1)-3234)
(ORO-3234-6) CFSTI: HC $3.00/MF $0.65

Research is reported on the following topics: chlorine isotope effects in the hydrolysis of substituted benzoyl chlorides; effects of ^{14}C on peroxybenzoic acid oxidation of *p*-substituted acetophenones; isotope effects on timing of bond changes in rearrangements to positively charged carbon; isotope effects on the mechanisms of Curtis, Hofmann, and Lossen rearrangements; effects of ^{14}C on nucleophilic displacement reactions of substituted benzyl chlorides; mechanisms of acid-catalyzed rearrangements of carbonyl compounds; ^{18}O exchange between *p*-substituted benzophenones and water; ^{15}N exchange between substituted benzamides and ammonia; and deuterium tracer studies of the stereochemistry of carbene and carbenoid insertion reactions. NSA

N68-36902 Stanford Univ., Calif.
THERMODYNAMICS AND KINETICS OF ABSORPTION OF OXYGEN IN STAGNANT LIQUID SILVER AND SILVER BASE ALLOYS
Ishwarlal Dhanjee Shah (Ph.D. Thesis) 1967 238 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 67-17504

The solubilities of oxygen in liquid silver and silver-gold, silver-palladium and silver-platinum alloys have been determined in the range of 940 to 1200°C at one atm pressure of oxygen using an improved Sieverts technique. The solubility of oxygen in liquid silver can be represented by the following equation: $\log \%O = 695.4/T°K - 1.086$. The additions of gold (0 to 57%), platinum (0 to 27%) and palladium (0 to 22%) to liquid silver continuously decrease the solubility of oxygen in liquid silver. Palladium has the most marked effect. Activity coefficients and interaction parameters of oxygen in the alloys have been calculated from the experimental results. Dissert. Abstr.

N68-36903 Catholic Univ. of America, Washington, D. C.
STRUCTURAL RELAXATION IN A SERIES OF LOWER ALCOHOLS; LIGHT SCATTERING IN VISCOELASTIC FLUIDS
Charles J. Montrose, Jr. (Ph.D. Thesis) 1967 103 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17148

The effects of steric hindrance and chain length variation in hydrogen-bonded liquids were studied. Ultrasonic measurements were performed in the neoalcohols in the 10–300 MHz region over a temperature range −70° to +30°C. To supplement these data measurements of the spectrum of light inelastically scattered from density fluctuations in the liquids were made over a similar temperature range. The experimental ultrasonic absorption and velocity data in the neoalcohols show clearly the existence of two relaxation mechanisms in these liquids. The lower frequency relaxation process was adequately described by a single relaxation time. The magnitude and temperature dependence of the relaxational modulus M_r were compared with similar data in 1-propanol. A comparison of the dielectric and structural relaxation times was given. Dissert. Abstr.

N68-36906# Michigan State Univ., East Lansing.
RAMAN SPECTRA OF POLYCRYSTALLINE H_2S AND D_2S
R. E. Miller (Princeton Univ.) and G. E. Leroi (Princeton Univ.) May 1968 28 p refs Submitted for publication
(Contract N00014-68-A-0109-0003)
(TR-3(28); AD-669501)

The Raman spectra of H2S and D2S were obtained in all three solid modifications, using both conventional and laser

excitation. The spectra in the two higher temperature phases are consistent with their known disordered crystal structures. Previously undetected vibrational structure also has been obtained for both the internal and lattice vibrations in the lowest temperature phase (III); an assignment of the entire spectrum is proposed. Conclusions about the crystal structure of this phase, which has not been previously established, can be drawn from the combined results of X-ray, electron diffraction, infrared, far-infrared, and Raman investigations. It is shown that a C4H structure with 8 molecules per unit cell on C1 sites fits all the data for phase III of H2S and D2S. Author (TAB)

N68-36950# Battelle Memorial Inst., Columbus, Ohio. Pacific Northwest Lab.

PACIFIC NORTHWEST LABORATORY, DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT, OCTOBER–DECEMBER, 1967

R. L. Moore, ed. 5 Feb. 1968 38 p refs
(Contract AT(45-1)-1830)
(BNWL-680) CFSTI: HC$3.00/MF$0.65

Studies dealing with promethium purification and conversion, the properties of promethium oxide, and the characteristics of radioisotopic heat sources are reported. Improvements were made in equipment and flow sheets used for producing purified promethium 147 and for its conversion to heat source grade sesquioxide. Changes in hot-cell ion-exchange equipment are noted, including that most of the ion-exchange columns are now made of stainless steel construction and more nearly optimum sizing had been achieved. Nitrilotriacetic acid was found to give higher processing rates, lower reagent costs, and more favorable elution sequence than diethylenetriaminepentacetic acid; and the solubility of promethium oxalate and conditions for its optimum recovery were investigated. Thermal diffusivity of Pm_2O_3 was measured from 80 to 1600°C as a function of Sm_2O_3 content; and the Sm_2O_3 had little effect on the thermal conductivity. Observations of hydrolysis of Nd_2O_3, Pm_2O_3, and Sm_2O_3 were made; and formation of mixed oxides offered no protection for the spreading of Pm^{147} in aqueous solutions. M.W.R.

N68-36959# Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry.

THE NATURE OF OXYGEN CONTAINING RADICALS IN RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF AQUEOUS SOLUTIONS Technical Progress Report, 1 Sep. 1967–1 Jul. 1968

Gideon Czapski 1 Jul. 1968 40 p refs
(Contract AT(30-1)-3753)
(NYO-3753-3) CFSTI: HC$3.00/MF$0.65

The known properties of oxygen-containing species in irradiated aqueous solutions are summarized. The HO_2 radical was found to exist in 3 forms in the pH range from 0 to 7. O_3^- was found in alkaline solutions. The OH − radical is shown to exist in 2 forms with its pK = 11.8. Its absorption in the ultraviolet has a shoulder around 2600Å. It is shown that H_2O_3 is formed from recombination of HO_2 and OH radicals in acid solutions. NSA

N68-36963# Kernforschungsanlage, Juelich (West Germany).

XENON: PHYSICAL AND PHYSICAL-CHEMICAL PROPERTIES–A LITERATURE COMPILATION [XENON PHYSIKALISCHE UND PHYSIKALISCH-CHEMISCHE EIGENSCHAFTEN' EINE LITERATURZUSAMMENSTELLUNG

G. Gehrke and E. Paul Oct. 1967 54 p refs In GERMAN and ENGLISH
(JUL-BIBL-13)

The literature compilation covers the years 1947 to 1967 and contains 615 titles. The references are arranged under the headings: general, thermodynamics, transport properties, reactions of xenon with solids (accommodation coefficients), solubility of xenon in liquids, liquid xenon, solid xenon, other physical properties and effects, and occurrence and production of xenon. An author index is included. NSA

N68-36975# Los Alamos Scientific Lab., N. Mex.

THE TIME-DEPENDENT REACTION ZONES OF IDEAL GASES, NITROMETHANE, AND LIQUID TNT

Charles L. Mader Aug. 1967 28 p
(Contract W-7405-ENG-36)
(LA-3764) CFSTI: HC$3.00/MF$0.65

The time-dependent reaction zones of ideal gases, nitromethane, and liquid TNT were investigated using two-dimensional Lagrangian and Eulerian numerical hydrodynamics with Arrhenius chemical reaction and accurate equations of state. The unperturbed two-dimensional Lagrangian and Eulerian calculations yielded the same results regarding the stability of the steady-state solutions of the reaction zone as did previously reported calculations using one-dimensional Lagrangian and characteristic methods. The perturbed two-dimensional Lagrangian and Eulerian calculations reproduced the analytical predictions of Erpenbeck regarding the stability of the ideal gas reaction zone in two dimensions and indicated that the stabilities of the reaction zones of nitromethane and liquid TNT are identical in one and two dimensions. Author (NSA)

N68-36986# Technische Hochschule Munchen (West Germany).

NITROSYL COMPLEXES OF FERROUS METALS WITH SULPHUROUS AND NITROGENOUS LIGANDS OF TWOFOLD SYMMETRY [NITROSYLKOMPLEXE DER EISENMETALLE MIT ZWEIZAEHLIGEN SCHWEFEL- UND STICKSTOFFHALTIGEN LIGANDEN]

Klaus Kaiser (Ph.D. Thesis) 1968 61 p refs In GERMAN
CFSTI: HC$3.00/MF$0.65

Studied are various nitrogen oxide iron complexes formed during reactions of coordinated dimeric sulfur- and nitrogen containing organic compounds with iron-, cobalt-, and nickel nitrosyl halogens. Ferrous dinitrosyl bromide formed with thioamides, 2-mercaptobenzene thiazole, O-aminothiophenole, cysteamine, tetramethyl biphosphine disulfide, and several nitrogen containing bases paramagnetic iron-nitrogen complexes of the type $[(ON)_2Fe(L_2)]+Br^-$; also obtained were complexes with two ligand molecules of the type $[(ON)_2Fe(L_2)_2]+Br^-$. Dimeric ligand reactions of sulfur- and nitrogen donor atoms with cobalt dinitrosyl bromide resulted in diamagnetic cobalt-nitrogen complexes of the formula $(ON)_2Co(L_2)+Br^-$. Various structural and bonding aspects of the metal nitrogen ligand strengths are analyzed by evaluation of their NO valence frequencies. Transl. by G.G.

N68-36997# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

HYDROLYSIS OF THORIUM DICARBIDE AND OF MIXED URANIUM-THORIUM DICARBIDES [L'HYDROLYSE DU DICARBURE DE THORIUM ET DES DICARBURES MIXTES D'URANIUM ET DE THORIUM]

Bernard Del Litto (Ph.D. Thesis) 1967 68 p refs In FRENCH
(CEA-R-3215)

The hydrolysis of thorium dicarbide leads to the formation of a complex mixture of gaseous and condensed hydrocarbons. The temperature, between 25 and 100°C, has no influence on the nature and composition of the gas phase. The reaction kinetics, however, are strongly temperature dependent. In a hydrochloric medium, an enrichment in hydrogen of the gas mixture is observed. A decrease in hydrogen and an increase in acetylene content take place in an oxidizing medium. The general results can be satisfactorily interpreted through a reaction mechanism involving C–C radical groups. The hydrolysis of uranium–thorium–carbon ternary

alloys leads to the formation of gaseous and condensed hydrocarbons. The variation of the composition of the gas phase versus uranium content in the alloy suggests an hypothesis about the carbon–carbon distance in the alloy crystal lattice.
Author (NSA)

N68-37008# Leeds Univ. (England). Physical Chemistry Dept.
HIGH TEMPERATURE REACTION RATE DATA
D. L. Baulch, D. D. Drysdale, and A. C. Lloyd May 1968 38 p refs Sponsored by Office for Sci. and Tech. Inform.
CFSTI: HC$3.00/MF$0.65

This report is the first of a series from the evaluation project. Some homogeneous gas phase reactions involving carbon monoxide have been evaluated. A separate section is devoted to each reaction and, in general, the order of material presented within each section is as follows:- Thermodynamic data, recommended value of rate constant, Arrhenius plot of available data, table of available data, discussion, references. Thermodynamic data were obtained from two sources. The recommended value of a rate constant denotes that value which, in the opinion of the authors, is most consistent with the available experimental and thermodynamic data. In certain cases, where there is a paucity of reliable data, the authors have not felt justified in selecting a preferred value. The arguments used to arrive at the recommended value are outlined in the discussion. The errors quoted apply to the middle of the temperature range studied and were determined simply by drawing lines through the extreme values of the Arrhenius plot. In the majority of cases the scatter of experimental points is such that no more sophisticated treatment of errors seems justified, particularly because there is no 'clear-cut' means of assigning weighting factors.
Author (ESRO)

N68-37009# Maryland Univ., College Park. Computer Science Center.
AXIAL DISPERSION IN A TUBULAR FLOW VESSEL WITH BENDS
Chan Mo Park (Ph.D. Thesis) 1 Sep. 1968 198 p refs

A pulse technique with two measurement points was employed in determination of axial dispersion coefficients. The experimental apparatus consisted of 3/4 inch diam pipe with four 90° bends located at 50 inch intervals. Three mathematical models were considered to represent a reactor with bends. One was a model which assumed that the bend section was a perfectly mixed reactor with a certain equivalent length. The second assumed a fixed equivalent length for the bend section and a proportional relationship between the dispersion coefficients in the bend and the straight section. The third model considered the whole reactor as a straight pipe with additional length added to the actual length to account for the effect of the bend. Two computer programs, one for an analytical solution of a first order chemical reaction, and the other for a numerical approximation by finite difference method for any order reactions, are presented. They can be used to compute the final conversion rates in a simple reactor and in a mixed reactor consisting of reactor sections with different axial dispersion values.
Author

N68-37010# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
FAST RADIOCHEMICAL SEPARATIONS BASED ON THE SZILARD–CHALMERS-EFFECT IN LANTHANIDE COMPLEXES WITH POLYAMINE–POLYCARBOXILIC ACIDS. 1. SEPARATION OF GENETICALLY COUPLED ISOBAR AND ISOMER PAIRS
G. Yu. Baier, V. A. Khalkin, and Kh. Grosse-Ryuken 1968 19 p refs In RUSSIAN; ENGLISH summary
(JINR-P12-3886)

Batch and continuous methods for separating genetically coupled isobar and isomer lanthanide pairs were developed, based on the Szilard–Chalmers effect in lanthanide complexes with ethylenediaminetetraacetic acid (EDTA) and diethylenetriaminepentaacetic acid (DTPA). Better results were obtained using DTPA. In the case of the batch method for separations of $^{134}Ce/^{134}La$, $^{140}Nd/^{140}Pr$, and $^{160m}Ho^{160g}Ho$ the yield of daughter isotopes was 70%, whereas mother isotope admixture was 0.05 to 0.5%. In the case of continuous separation of ^{140}Pr from ^{140}Nd adsorbed as a complex with DTPA using an anion exchange column, the yield of the daughter isotope was $30 \pm 15\%$, whereas the admixture was $0.25 \pm 0.05\%$.
Author (NSA)

N68-37038# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF THE (U, Pu)C,N SYSTEM [CONTRIBUTION A L'ETUDE DU SYSTEME (U, Pu)C,N]
Robert Lorenzelli May 1968 89 p refs In FRENCH; ENGLISH summary
(CEA-R-3536) CFSTI: HC$3.00/MF$0.65

The reactions of UC, PuC, (U,Pu)C, UC_2 and $U(C_{1-x}O_x)$ with nitrogen at moderate temperatures (room temperature to 400°C) are described. The influence of the uptake of nitrogen by the powders necessary to sinter the carbides upon the nature of the final product has been investigated; it has been shown that the sintered carbides are hyperstoichiometric. The reactions of carbon with UN, PuN and (U,Pu)N has also been studied. Under vacuum, carbon reacts on the nitrides at temperatures as low as 1100°C; nitrogen is replaced by carbon and the final product is a carbonitride. The reaction is: $MN + x\,C \rightarrow MN1-xC_x + x/2\,N_2$ The reaction is limited and the carbonitrides have a fixed composition in presence of M_2C_3 or MC_2; hence it is impossible to produce pure MC using the reaction. The ternary diagram U-C-N, Pu-C-N and (U,Pu)C-N have been drawn. They show clearly that it is possible to obtain single phase carbonitrides in a wide domain of compositions.
Author (ESRO)

N68-37082# Technische Hogeschool Eindhoven (Netherlands).
LIGAND HYPERFINE STRUCTURE IN THE ESR SPECTRA OF THE IONS Mo OF $_6^{2-}$ AND OF $_6^{2-}$
Johannes Leonardus Verbeek (Ph.D. Thesis) 5 Mar. 1968 80 p refs
CFSTI: HC$3.00/MF$0.65

The work described consists of two closely related parts, the first being an attempt to interpret the ligand hyperfine structure in ions of the general type MOX_5^{2-}, with M a transition metal ion, and X a halogen; this is done by means of a simple but pictorial model. The second part contains a brief review of recent opinions on the nature of the electronic structure of those complexes. After a résumé of relevant parts of the theory of electron spin resonance, a model of ligand-electron-interaction is proposed, using a simple dipole-dipole-interaction mechanism. As a consequence of the experimental limitations, being constrained to the use of polycrystalline samples, the peculiarities of the ESR spectra of such samples are discussed in some detail. The theoretical framework now being complete, the experimental data are presented, and an interpretation is given. A check of this interpretation lies in the comparison of X- and Q-band spectra, and in the use of isotopes of the metals. Within the restrictions imposed by the lack of experiments with single crystals, the given interpretation is satisfactory. In an attempt to decide between diverging opinions in the literature, semi-empirical calculations of the electronic structure of the present ions were carried out. The results of such calculations turned out to be extremely sensitive towards certain presuppositions, and appeared inadequate to make positive statements as to the correctness of any of the opinions

put forward by the various authors. Some propositions from the literature are presented in some detail. The conclusion is drawn that a reliable ab-initio calculation, for instance of the unrestricted Hartree-Fock type, may be the only way out of the difficulties. Author (ESRO)

N68-37087# Production Group, United Kingdom Atomic Energy Authority, Sellafield (England).
ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM BY AMPEROMETRIC TITRATION (ARGENTIC OXIDATION, FERROUS REDUCTION)
J. Cherry, J. Holmes, and J. J. B. Williams 1968 12 p
(PG-832) CFSTI: HC $3.00/MF $0.65

The plutonium, in dilute sulfuric acid solution, is oxidized to plutonium(VI) with silver(II) oxide; excess of the oxidant is then destroyed with sulfamic acid. Plutonium(VI) is reduced to plutonium(IV) by adding a slight excess of a standard solution of iron(II). The excess is determined by titrating with a standard solution of potassium dichromate. The end points for reduction with iron(II) and oxidation with dichromate are obtained amperometrically with two platinum electrodes. There is no detectable bias and the coefficient of variation at the 40 mg level of plutonium is 0.035%. The method is applicable to the determination of plutonium in plutonium metal or oxide. It may also be used for the determination of plutonium in the form of chloride, fluoride, nitrate or sulfate and in alloys containing uranium and iron if the plutonium content is greater than 5%. Cerium, chromium, vanadium manganese, and neptunium interfere quantitatively. Author (NSA)

N68-37094# State Univ. of New York at Buffalo. Dept. of Chemistry.
STUDIES IN SOLUTION AND NUCLEAR CHEMISTRY Progress Report, Oct. 1, 1967–Sep. 30, 1968
Jacob A. Marinsky and George A. Clarke 1 Jul. 1968 323 p refs
(Contract AT(30-1)-2269)
(NYO-2269-12) CFSTI: HC $3.00/MF $0.65

A report is given of research to elucidate the ion-exchange phenomenon; to study the solution chemistry of the alkali metals, the alkaline earths, and the transition elements in the presence of linear and crosslinked polyelectrolytes; and to extend theoretical development of a polyelectrolyte model for the knowledge interpretation of experimental results. Various ion-forms of Dowex-50 resin, its polyelectrolyte analog, polystyrene sulfonic acid, Amberlite IRC-50 resin, its linear polyelectrolyte analog, polymethacrylic acid, and poly-L-glutamic acid were and are being employed to facilitate these objectives. Investigation reported of solvent selectivity as well as ion-exchange selectivity of Linde-A zeolite in nonaqueous and mixed media is especially pertinent to the first objective listed. Ion exchange as well as polarographic and potentiometric techniques continue to be employed to accomplish the goals of this program. Spectral and osmotic studies proved extremely useful to the program as well. Author (NSA)

N68-37100# Delaware Univ., Newark. Dept. of Chemistry.
STUDIES ON PRIMARY PROCESSES IN THE RADIATION CHEMISTRY OF LIQUIDS AND ON THE MECHANISM OF THE INTERACTION OF RADIATION WITH BIOLOGICALLY IMPORTANT CHEMICAL SYSTEMS Progress Report, Feb. 14, 1967–May 7, 1968
Conrad N. Trumbore 7 May 1968 13 p refs
(Contract AT(30-1)-3383)
(NYO-3383-13) CFSTI: HC $3.00/MF $0.65

Studies of several different chemical systems have led to speculation that there may be relatively long lived precursors of the commonly invoked intermediates in aqueous radiation chemistry, H, OH, and e^-_{aq}. In the pulse radiolysis of alkaline solutions a fast decay of what is thought to be the hydrated electron was found to be exceedingly sensitive to the addition of a compound which computer calculations show should not substantially affect this decay. In two other chemical systems, aqueous p-nitrosodimethylaniline and cysteine, nonclassical behaviour was demonstrated, especially at low pH and low solute concentrations. In the pulse radiolysis of the p-nitrosodimethylaniline system certain rate constants were found to be an order of magnitude above normal diffusion limited ones, implying very rapid energy transfer. Studies of the benzene-cyclopentanone system showed that there are similar excited states in the photo-chemistry and radiation chemistry of benzene and that the results of the photochemical and fluorescence studies demand either unorthodox explanations of the excited states involved or unusual spin-forbidden processes. Author (NSA)

N68-37102# Oak Ridge National Lab., Tenn.
REVIEW OF ORNL ELECTROMAGNETIC SEPARATIONS PROGRAM, 1966–1967
L. O. Love and W. A. Bell Jul. 1968 78 p refs
(Contract W-7405-ENG-26)
(ORNL-4271) CFSTI: HC $3.00/MF $0.65

Research progress is reported under the following headings: stable isotopes separated, separations typifying progress in methods, isotope usage, calutron feed advancements, isotope receiver improvements, ion source development, radioactive gas separation, ion implantation, natural element contamination and problems of retention of low-abundance isotopes, sector separator, inhomogeneous-field 255° separator, and heavy-element separations. NSA

N68-37180# Pennsylvania State Univ., University Park. Materials Research Lab.
COMPREHENSIVE SURVEY OF OXYGEN X-RAY EMISSION BAND SHIFTS
K. Krause and E. W. White Aug. 1968 21 p refs
(Contract N00014-67-A-0385)
(TR-2; AD-673321)

Shifts in the oxygen K-emission band from some fifty simple oxide compounds were studied as part of a program to evaluate soft X-ray spectroscopy as a tool for characterizing thin layers on metals. The main peak tends to shift to shorter wavelengths as the valence of the coordinating cation increases. For oxides of transition metal element one can determine the cation valence from the O–K–alpha position. For the oxide of the non-transition metals the oxygen peaks tend to be relatively narrow and exhibit little or no resolved fine structure. For oxides containing highly charged cations the OK–beta' band becomes a well-resolved feature on the long wavelength side of the main peak. Author (TAB)

N68-37196# United Kingdom Atomic Energy Authority, Harwell (England).
THE DETERMINATION OF HYDROGEN AND DEUTERIUM IN ZIRCONIUM ALLOYS USING AN MS 10 MASS SPECTROMETER
K. R. J. Cottell, Marion Quarmby, and H. I. Shalgosky Mar. 1968 6 p refs
(AERE-R-5758) CFSTI: HC $3.00/MF $0.65

An MS10 mass spectrometer was connected to a hot vacuum extraction system and calibrated for measurements of hydrogen, deuterium, and hydrogen deuteride. Analysis of samples of Zircaloys showed that the coefficients of variation for single determinations of hydrogen and deuterium were ±1.2 and ±2.8%, respectively; the limits of detection were 0.03 and 0.0017 μg, respectively. Author (NSA)

N68-37226*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Progress Report, 9 Apr.–9 Aug. 1968
K. S. Spiegler, J. C. Th. Kwak, D. A. Zelman, and J. Leibovitz 9 Aug. 1968 22 p Prepared for JPL
(Contracts NAS7-100; JPL-952109)
(NASA-CR-97224; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07A

Construction of a cell suitable for the measurement of different membrane transport properties is reported. In this cell, osmosis, electro-osmosis, dialysis, transport number, membrane potential, streaming potential, and conductivity measurements can be performed under uniform hydrodynamical conditions. Various auxiliaries e.g. conductivity cells, conductivity electrodes, and Ag/AgCl electrodes have been made. The electrical part of a concentration feedback mechanism for the two cell compartments was assembled and tested. Author

N68-37248# California Inst. of Tech., Pasadena. Gates and Crellin Labs. of Chemistry.
LIGAND BRIDGING BY HALIDE IN THE ELECTROCHEMICAL OXIDATION OF CHROMIUM(II) AT MERCURY ELECTRODES
Janet Jones Ulrich and Fred C. Anson [1968] 27 p refs

A variety of electrochemical techniques were employed to investigate the mechanism of oxidation of chromium(II) at mercury electrodes in the presence of chloride, bromide, and iodide. The results show that halide catalyzes the reaction and leads to halide-containing Cr(III) products according to $X^- + Cr(II) \rightarrow CrX^{2+} + e^-$. In the case of chloride and bromide at least, the homogeneous complexation reaction to form CrX^+ does not precede the electrode reaction. A variety of data on the potential dependence of the reaction products strongly suggests that, when it is adsorbed on the electrode, halide can act as an electron bridge and facilitate the oxidation. Author

N68-37294 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.
DIFFUSION AND SURFACE REACTIONS OF SINGLET EXCITONS IN ANTHRACENE
B. J. Mulder (Ph.D. Thesis—Tech. Univ., Eindhoven) 1968 136 p refs *Its* Res. Rept. Suppl. no. 4

The concentration of excitons at the illuminated surface of anthracene crystals is calculated as a function of the excitation depth and the mean diffusion length of the excitons in the crystal. In the calculations the reabsorption of fluorescent light is taken into account. To this end the spectral distribution of the primary fluorescence, undistorted by reabsorption, was measured on microcrystals embedded in aqueous solutions of sodium sulphite. It turns out that the exciton concentration at the surface of the (fluorescent) anthracene crystals varies with the excitation depth in the same manner as would be found for a non-fluorescent crystal with a 1·5 times greater exciton diffusion length. The variation of the exciton concentration with excitation depth at the surface of anthracene crystals is studied experimentally from the quenching of the crystal fluorescence, the photoconduction and the "sensitized" fluorescence emitted by very small amounts of organic dyes adsorbed from aqueous solutions at the surface of the crystal. The three types of measurements are consistent, leading to the same value of the exciton diffusion length, when an organic dye is used as the active quenching agent at the surface. The same value of the exciton diffusion length is also found when the photoconduction spectrum is measured with a dilute solution of alkali as the electrode. Author

N68-37341# Battelle Memorial Inst., Columbus, Ohio.
INORGANIC CHEMICAL REACTIONS AND SYNTHESIS UNDER HIGH PRESSURE AND HIGH TEMPERATURE Final Report, 1 Apr. 1965–31 Jul. 1968
A. E. Austin and C. B. Sclar 31 Jul. 1968 12 p refs
(Contract DA-ARO(D)-31-124-G-673)
(AROD-5689-3-C; AD-673295)

This investigation was a study of inorganic chemical reactions and phase equilibria under high pressures and concomitant high temperatures. It consisted of two parts. The first was the study of the pressure-temperature dependence of oxidation-reduction reactions between inorganic solids. The second was the study of phase equilibria in the ternary system MGO-sI02–H2). These two parts are reported in separate sections for continuity. Author (TAB)

N68-37352# Technische Hochschule Hannover (West Germany).
MEASUREMENT OF THE VISCOSITY OF FUSED ALUMINUM HALIDES USING THE HOLLOW BODY-TENSION METHOD [DIE MESSUNG DER VISKOSITAET GESCHMOLZENER ALUMINIUMHALOGENIDE NACH DER HOHLKOERPER-TORSIONSMETHODE]
Peter Kleinschmit (Ph.D. Thesis) 1968 101 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

High temperature molten aluminum salts were enclosed in hollow glass pendulums and their viscosity was determined by interpolation of pendulum oscillations and damping forces caused by cooling effects on specific volumes. Obtained were viscosity values for aluminum bromide, aluminum iodide, and aluminum chloride. Results showed that the boiling point viscosity increased steadily from aluminum chloride to aluminum iodide and it was concluded that the molten particle size increases from the chloride to the iodide. Transl. by G.G.

N68-37359# Technische Hochschule Munchen (West Germany).
VINYL GUANIDIUM IONS: A NEW CLASS OF CATIONIC POLYMETHYL DYES [VINYLOGE GUANIDINIUM-IONEN, EINE NEUE KLASSE KATIONISCHER POLYMETHINFARBSTOFFE]
Ernst Mueller (Ph.D. Thesis) 1968 90 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Amidinium resonance of ketene-N,N-acetale (II) was used to increase the electron density of the methylene carbon atom in a polymethine chain. New dye cations (III) were obtained with the resonance system of the guanidinium ions in which the polymethine chain was prolonged by two vinylene dipoles. Reactions with (I) -trimethines gave (III)-heptamethine (n = 1), reactions with (I) -pentamethine gave (III)-nonamethine (n = 2). Also obtained were bis-benzimidazole-cyanines with chain substitutions. Transl. by G.G.

N68-37360# Technische Hochschule Munchen (West Germany).
VILSMEIER AND CONDENSATION REACTIONS WITH PYRROLINONS-(2) AND ISOINDOLINONS-(1) [VILSMEIER UND KONDENSATIONS-REAKTIONEN MIT PYRROLINONEN-(2) UND ISOINDOLINONEN-(1)]
Horst Reinhard (Ph.D. Thesis) 1968 82 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Studied were carboxylation and condensation reactions with pyrrolinones-(2) and isoindolinones-(1). Carboxylation of 1-acetyl-pyrrolinone-(2) gave 1-[3-halogen-propenylaldehyde-(3)] -pyrrolinone-(2); carboxylation of isoindolinone-(1) resulted in stable N-free halogen-formyl-isoindoles with immonium salts as intermediate products. The structures of the aldehydes, immonium

salts, and enamines were confirmed by NMR spectrum analyses. Very stable N-free isoindole derivatives were also obtained by pyridylation of 3-monosubstituted isoindolinones-(1).
Transl. by G.G.

N68-37367# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Engineering Materials Lab.
EFFECT OF LOW CONCENTRATIONS OF ACID AND WATER ON THE CORROSION OF METALS IN ORGANIC SOLVENTS
J. J. Demo, Jr. [1968] 38 p refs

In the class of organic solvents that dissolve large amounts of water, the presence of low concentrations of acids can cause extremely severe corrosion of many materials of construction. Examples of such solvents are dimethylformamide, n-butyl alcohol, and propylene carbonate. In addition to proper selection of materials, corrosion in these contaminated solvents can be reduced by the addition of certain inorganic salts. Corrosion inhibition, especially on stainless steel alloys, can also be achieved through additions of small amounts of water. For organic solvents in general, the occurrence of corrosion depends primarily on conductivities and acid content. With conductivities greater than 10^{-7} ohm^{-1} cm^{-1}, corrosion becomes increasingly severe as acidity increases. If solution conductivities are less than 10^{-7} ohm^{-1} cm^{-1}, corrosion rates are low, even in the presence of high acid content.
Author

N68-37409*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 109-115 refs (See N68-37397 23-11)

The initiation of a systematic study of various transport characteristics of membranes (battery separator) which was undertaken in an attempt to ascertain the chemical and morphological requirements that lead to desirable permselective properties: is reported. Reviewed are results of studies of the electrical properties of cells prepared with ionene membranes.
S.C.W.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-36046 State Univ. of Iowa, Iowa City.
BURST-ERROR AND RANDOM-ERROR CORRECTION
Nazmi Mohamad Shehadeh (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-16838

Correction of combination and simultaneous burst-errors and random-error is discussed. Upper and lower bounds on r, the number of parity-check digits in a code word of length n, for block codes are developed. The interlaced code is introduced and the degree of interlacing is defined. It is shown that this code can be used for the correction of these classes of errors. Cyclic codes and especially the Bose-Chaudhuri-Hocquenghem (BCH) codes can be used for the correction of these classes too. It is shown that product codes are capable of correcting these classes of errors, especially those with long burst-errors. A theorem is given that shows that if a code can correct the combination of burst-errors and random-errors, then it can correct burst-errors and random-errors simultaneously. Examples are given to compare the performance of these codes, with respect to the number of parity-check digits used, with those obtained from the upper and lower bounds.
Dissert. Abstr.

N68-36050 California Univ., Los Angeles.
SAMPLE COMPRESSION SYSTEM EVALUATION
Robert Burns Kelley (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-222

The nonadaptive schemes, the previous sample predictor, fits the data with piecewise constant sample values, and only these constant sample values and their locations among the original samples need to be transmitted. The data is modeled as a finite Markov chain with all main diagonal transition probabilities equal but of otherwise arbitrary structure. For such data sources, the previous sample predictor obtains the maximum sample compression possible. Message fidelity is measured by the probability of error between randomly selected samples in the original and reconstructed messages. Bounds of an especially simple form are derived. A combination of simulation and Monte Carlo estimation is presented. Two ways to convey the location information are considered in detail: 'coma' sequence encoding and 'absolute' location encoding. By introducing the notion of equivalent energy compression, the overall compression relative to a noncompression system with the same probability of error can be obtained. Compression systems can be compared with one another. The source coding efficiency—bit compression—dominated the overall compression realized.
Dissert. Abstr.

N68-36105*# National Aeronautics and Space Administration, Electronics Research Center, Cambridge, Mass.
ERROR PROBABILITIES FOR MAXIMUM LIKELIHOOD DETECTION OF M-ARY POISSON PROCESSES IN POISSON NOISE
Sherman Karp, Martin G. Hurwitz, and Robert M. Gagliardi (Univ. of Southern Calif., Los Angeles) Washington Oct. 1968 48 p refs
(NASA-TN-D-4721) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Some of the recent results in the detection of a Poisson distributed signal in Poisson noise are considered. Curves for error probabilities are presented for the case of detecting one of M equiprobable signals over a broad range of parameter values. Implicit in these results for system applications is the use of photon counting receivers. Attention is given to the optical communication and radar problems for this receiver structure and significant parameters are translated into those used in the report. A complete description of the computational procedures used for making the error probability calculations is given.
Author

N68-36148 Cornell Univ., Ithaca, N. Y.
OPTIMUM SIGNALS FOR RADAR UTILIZING THE AMBIGUITY FUNCTION AS THE ERROR CRITERION
Julian Charles Holtzman (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17238

The research reported here deals with the general problem of the selection of radar waveforms. The investigation is specifically concerned with the synthesis of radar signals which are optimum in the sense that they are characterized by ambiguity surfaces minimized over certain predetermined regions of the ambiguity plane. The ambiguity function is shown to be a parameter of the probability of detection of multiple targets thereby providing a numerical measure of resolution. The weighted ambiguity surface is utilized as the weighted error criterion. This error criterion is mathematically tractable and pertinent to radar system performance but is not unduly restrictive as some orientation parameters are left unspecified for subsequent cost or penalty function analysis. It is

also shown that the weighted ambiguity surface is the sampled output of a matched filter radar operating in a dense target environment. Dissert. Abstr.

N68-36156# Harry Diamond Labs., Washington, D. C.
DESIGN OF ACTIVE 90-DEGREE PHASE DIFFERENCE NETWORKS
Ronald Sebol May 1968 21 p refs
(HDL-TM-68-18; AD-673702)

An active all-pass network that has two real axis poles and mirror image zeroes is analyzed and a means of realizing even-order 90-degree phase difference networks with this circuit is demonstrated. A step-by-step design procedure and the schematic of an 8th-order network constructed thereby are presented. Author (TAB)

N68-36169*# Alabama Univ., University. Coll. of Engineering.
STUDY OF INEXACT MODELING TECHNIQUES Final Report
Harold Mott, and David N. McQuiddy, Jr., and James E. Dudgeon 31 Aug. 1968 114 p refs
(Grant NGR-01-002-036)
(NASA-CR-97114) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Problems and philosophy of inexact modeling of antenna systems for aircraft and missile applications are discussed. The pattern effect of reradiating objects in the primary field is analyzed, and the theory concerned with the size, shape and distance from the primary radiator is presented. Pattern measurements of a slot antenna in a ground phase with a disturbing post mounted on the ground plane were made in order to verify the results of the preceding analysis and to give experience in the magnitude of the disturbance effect for typical pattern-disturbing objects. The effect of conductivity on the frequency scaling of a 5 to 40 GHz antenna, and range of validity for scaling an antenna in size and frequency are discussed, along with the effect of surface roughness on radiating patterns. A technique for studying antenna patterns in anechoic rooms or on outdoor ranges is developed using a binary coded signal which suppresses undesired reflected signals. A variation of the same process supresses the primary signal and alloys the reflections in an anechoic room to be measured. D.A.E.

N68-36176*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
INTERSTATION CONNECTIONS FROM GEOS 1 OPTICAL BEACON OBSERVATIONS
Jan Rolff *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 17–24 refs (See N68-36174 23-13)

The Smithsonian Astrophysical Observatory has incorporated Geos 1 optical beacon observations from other agencies into its scientific programs. Useful observations were produced by five individual stations in Europe. More data are needed before definite results in interstation connections can be established. Author

N68-36182*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DATA PREPARATION AND EVALUATION FOR GEOS 1 TRACKING SYSTEMS
L. H. Solomon *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 129–143 refs (See N68-36174 23-13)

Preparation and use of data were studied from the various tracking systems, particularly electronic systems, carried aboard Geos 1. The data were converted into a format usable at SAO, the relative accuracies of the several tracking system were investigated, and the various data were tested together in determining orbits and station coordinates. Author

N68-36183*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
REDUCTION AND ACCURACY OF BAKER–NUNN OBSERVATIONS OF GEOS 1
Kurt Lambeck and Leo J. McGrath, Jr. *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 145–150 refs (See N68-36174 23-13)

The techniques employed in the reduction of Baker–Nunn observations of Geos are discussed. An accuracy study of the observations has been carried out; and a summary of the results, as applicable to Geos observations, is presented. Author

N68-36250# Joint Publications Research Service, New York.
HOW MAN MIGHT COMMUNICATE WITH OTHER PLANETS
D. Kulin *In its* Prob. of Space Res. Invest. 18 Sep. 1968 p 13–18 (See N68-36248 23-04)

The transmission of enciphered radio signals to highly developed extraterrestrial life is proposed. The enciphering and deciphering of a specific message are depicted. Communication with radio signals is based on the assumption that the laws of physics govern the entire universe, and that sensitive receivers are available. B.P.

N68-36296# Boeing Co., Renton, Wash. Commercial Airplane Div.
DORSAL-FIN SLOT ANTENNA FOR 707/SATELLITE COMMUNICATIONS
C. H. King 22 May 1968 47 p refs
(D6-23089; AD-673555)

The design of a flush-mounted slot antenna in the dorsal fin of a 707 jet airliner for air-to-ground VHF communications via satellite relay is discussed. The radiation patterns, impedance, and power handling capability of the antenna are described. Author (TAB)

N68-36332*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
DATA MANAGEMENT TECHNIQUES FOR SPACE APPLICATIONS Final Report
John G. Barmby, Charles J. Milsud, and Howard J. Goldman Aug. 1968 30 p refs
(Contract NASr-65(25))
(NASA-CR-97117; TM-29) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A study was conducted of processing, analysis, and archiving problems associated with data from spacecraft sensors utilized for space applications. The objective was to determine possible sensor and instrumentation modifications for improving data management, for minimizing data transmission requirements, and for making the data more useful. The emphasis was upon defining areas of promising technology developments rather than upon offering solutions to data processing problems. Author

N68-36333*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SELF-SYNCHRONIZING BI-ORTHOGONAL CODED PCM TELEMETRY SYSTEM
Warner Miller, Ronald Muller, Thomas Taylor, and John Yagelowich Washington Oct. 1968 29 p refs
(NASA-TR-R-292) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Details are given on the complete design, theory, and experimental statistics of a self-synchronizing, biorthogonal coded

PCM telemetry system for space communications. By selecting a proper code set, word synchronization is acquired without using a parallel channel and is maintained at a signal-to-noise ratio below 4 db. With the code's property of comma freedom, work synchronization can be achieved with a circuit requiring only a few logic modules. With the use of this circuit, signal detection can be performed in real time without the use of a computer. The measured probability of word error corresponds to a signal-to-noise ratio that is within 1 db of theoretical predictions; this is 3 db better than is obtained with the standard PCM systems now used on spacecraft. Author

N68-36349# Syracuse Univ. Research Corp., N Y. Defense Systems Div.

AN APPROACH TO MEASURING THE DIRECTION OF ARRIVAL OF RADIO WAVES IN THE PRESENCE OF WAVE INTERFERENCE

Stephen Edward Cooper (M.S. Thesis)
Jul. 1968 110 p refs (Contract Nonr-4798(00))
(DSD-R-206; AD-673547)

When two radio waves are reflected from the ionosphere and arrive at an antenna via two different elevation angles, the measurement of the angle of arrival of the stronger wave is influenced by the weaker interfering wave. This phenomenon is examined in detail, and an approach to measuring the elevation angle of the stronger wave is presented. In deriving completely general equations for the electric field in space, it is assumed that each wave is elliptically polarized and that they arrive at the antenna with a time phase difference, beta. An equation for the phase between the voltages induced in the antenna system is derived. This equation is analyzed using a digital computer to determine the effect of varying the relative field strength and beta. Assuming the angle of arrival of the stronger wave is desired, it is shown that the normal to the composite wavefront is in serious error with respect to this angle. The error is especially severe for beta near 180 degrees and for comparable field intensities. Since the polarization of each wave and beta are time dependent, the phase is averaged, assuming a random variation in beta and an arbitrary variation in polarization. It is shown that time averaging yields the phase associated with the elevation angle of the stronger wave, providing the stronger remained so throughout the averaging time. This is shown analytically and by use of a digital computer. Author (TAB)

N68-36351 Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Dept. Etudes.

PROCESSING OF TELEMETRY: SYNCHRONIZATION OF COMMUTED TELEMETRY DATA [TRAITEMENT DES TELEMESURES: LA SYNCHRONISATION DES TELEMESURES COMMUTEES]

M. Raclet and A. Pouzet Mar. 1968 33 p In FRENCH
CFSTI: HC $3.00

Telemetry data are received at the ground station as analog data. Their transformation to digital data is performed at the reception. Different means of transforming analog data to digital are given. ESRO

N68-36366# Radio Corp. of America, New York. Advanced Communications Lab.

SINGLE-FREQUENCY REPEATER Final Report, 15 Jun. 1967–15 Mar. 1968

G. Winram, H. Moore, and M. P. Rosenthal Ft. Monmouth, N. J. Army Electron. Command May 1968 82 p ref
(Contract DAAB07-67-C-0536; ARPA Order 694)
(CR-68-565-5-NY; ECOM-0536-F; AD-673852)

A study was made of the feasibility of using a Single-Frequency Repeater for extending the range (voice) of the AN/PRC-25 Radio Set. A feasibility model was designed using the principle of chopped, delayed voice; constructed; and tested in a limited manner. Test results are presented, as are general description and operating instructions. The results of the work done so far indicate that Single-Frequency Repeating can be used to repeat a voice-modulated, FM, RF signal and still retain some measure of intelligibility at the Receiving Terminal. The distance to which the effective range of a pair of AN/PRC-25 Radio Sets can be extended, using the model Repeater is not yet known, mostly because of insufficient performance measurements. Considerable extension is unquestionably possible if the modified AN/PRC-25 Retransmitter is replaced with a suitable Retransmitter. Some improvements to intelligibility can also be made, as evidenced by the limited experiments already carried out. One, for example, would be to implement synchronous audio blanking at the Remote Receiver during idle (non-transmit) times, thus eliminating the inevitable Receiver noise. Another would be to improve the quality of the audio input to the Retransmitter; it presently suffers from severe distortion. For example, an AGC amplifier used in place of the existing limiting arrangement would certainly offer significant improvement. Still other improvements could occur from optimizing the chopping rate, Guard Band, and the AF responses at both the Repeater and Remote Receivers. Author (TAB)

N68-36395# ARO, Inc., Arnold Air Force Station, Tenn.

ERROR ANALYSIS OF THE RECOVERY OF DATA ACQUIRED BY A VOLTAGE-TO-FREQUENCY DATA ACQUISITION SYSTEM FOR SINUSOIDAL, STEP, AND RAMP INPUTS Final Report, Apr. 1967–Jun. 1968

G. L. Williams Arnold Eng. Develop. Center Aug. 1968 41 p refs
(Contract F40600-69-C-0001)
(AEDC-TR-68-143; AD-673874)

The errors generated by the recovery of data acquired by a voltage-to-frequency (V/F) data acquisition system are theoretically analyzed, using a digital computer. The input waveforms considered are the sinusoid, the step function, and the ramp function. In each case, the well known sampling theorem of C. E. Shannon, viz. two samples per period of the smallest period present in the signal are sufficient for recovery of data with perfect fidelity, will be shown to be inapplicable as a criterion for accurate and reliable recovery of data acquired by a V/F system. The errors are of two categories: One is the error from linear interpolation recovery, and the other is from the fact that data points do not always coincide with the input. Author (TAB)

N68-36453*# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

PROGRAMMED COMPUTER CONTROL FOR LASER TRACKING Final Report, 16 Mar. 1967–22 Apr. 1968

J. J. O'Donnell, J. Glass, and S. Gajwani May 1968 215 p refs
(NAS8-21089)
(NASA-CR-61981; F-7180-1) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Documentation is presented on the design, implementation, and testing of a digital computer program, and the necessary interface hardware for control of an early-launch, laser tracking system. The control computer accepts angular pointing error information from a star tracker tube, phase error information from a laser ranging system, and mode control from a reacquisition system. During the tracking mode the computer provides drive signals for the tracking telescope in order to null angular pointing errors, and provides phase shift commands to the digital oscillator in the ranging system to null the phase and range error. In the

reacquisition mode the control computer outputs commands to the telescope drive and the range system oscillator, based on extrapolated target motion, so as to minimize initial errors when the track mode is reentered after target reacquisition. The program also computes target position, velocity, and acceleration in a launch-site-centered coordinate system. Provision is made for interfacing with printing, plotting, and magnetic tape units in order to display and store the tracking information. Data are included on the effects of random atmospheric turbulence on laser beam propagation. Author

N68-36476# Center for Naval Analyses, Washington, D. C. Operations Evaluation Group.
COMPUTER CALCULATION OF DISCRETE FOURIER TRANSFORMS USING THE FAST FOURIER TRANSFORM
J. C. Wilson Jun. 1968 20 p refs /ts OEG Res. Contrib.-81
(Contract N00014-68-A-0091)
(AD-673442)

This research contribution describes a computer program (CNA number 76-67) which determines the Discrete Fourier Transform of a set of data, using a recently developed technique known as the Fast Fourier transform. The relation between Discrete Fourier Transforms and Fourier Series when the data is periodic is also known. Author (TAB)

N68-36488* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APPLICATIONS OF RADAR TO SPACECRAFT AND SPACEFLIGHT
Richard F. Broderick, Richard G. Fenner, and Robert Chick [1968] 6 p refs Presented at the Southwestern Inst. of Elec. and Electron. Engr., Apr. 1966
(NASA-TM-X-60473) CFSTI: $3.00 CSCL 17I

Radar applications for the Gemini, Apollo, and Surveyor space programs are outlined. Mentioned were: (1) range rate and angle determining radar for rendezvous application and orbital calculations; (2) Doppler radar for use as a landing aid in soft landings of the Surveyor and Apollo LEM spacecraft; and (3) tracking radar used in conjunction with computers for orbit determinations. Boresight and flight test techniques for evaluation of spacecraft radar systems were reported. These tests included balloon and aircraft flights of radar equipment and are correlated with optical sightings. Side-looking radar capabilities for spacecraft applications were mentioned. Active and passive sensing systems were defined, and applications were given for each. Radar altimeter applications and research were also mentioned. D.A.E.

N68-36499*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADAR SCATTEROMETER DATA VALIDATION Final Report
Kenneth B. Craib 29 Mar. 1968 159 p refs
(NASA-TM-X-61291; MSC-CA-R-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 17I

After preliminary analysis, 17 magnetic tapes—recorded on missions 21, 23, 32, 35, and 36—were reviewed to determine the validity of scatterometer data gathered over Earth Resources Program test sites 2, 11, 32, 46, 76, 95, 102, and 104 during April to December of 1966. Sample power-spectral-density curves, time histories, and plots of radar backscattering versus incidence angle were prepared from each data tape. Aerial photographs obtained concurrently with these data and descriptions of the overflown terrains are presented. The techniques and methods used to obtain and to analyze these data are presented and discussed. Author

N68-36503# Aerospace Corp., El Segundo. Lab. Operations.
DESIGN CONSIDERATIONS OF MULTIPLE LASER COMMUNICATION LINKS BETWEEN SYNCHRONOUS SATELLITE AND SEVERAL EARTH STATIONS
N. C. Chang and E. G. Brock Sep. 1967 30 p refs
(Contract F04695-67-C-0158)
(TR-0158(9230-02)-1; SAMSO-TR-68-7; AD-673876)

Secure and private megabit-per-second communication links between a satellite in synchronous orbit and several ground stations are desired in certain applications. The highly directional property of laser beams makes laser waves an apt candidate for the carrier of the system. The large potential bandwidth of the laser system can be of value also in providing redundancy for reliability and coding for security. The very directional property of the laser beam, however, presents problems of pointing and acquisition. These problems are particularly severe for the case of simultaneous transmission between the satellite and multiple ground terminals. An additional problem of efficient optical antenna gain arises for this case. Recent advances in high-power, higher-efficiency lasers encourage consideration of a laser transmitter configuration not previously investigated for multiple link communication over synchronous satellite distances. In this configuration, a satellite-borne laser is operated in a relatively high-order mode. Appropriate optics are used to provide multiple links, one lobe of the beam for each link. Also mode switching can provide alternative links. The ground terminals are each equipped with separate lasers. Aside from poor atmospheric seeing, satellite attitude stability appears to be the key performance-limiting element of the system. Sample calculations of requirements and expected performance for the multiple communication link system are presented. Author (TAB)

N68-36672 Michigan Univ., Ann Arbor.
MONOPOLE ANTENNA WITH A FINITE GROUND PLANE IN THE PRESENCE OF AN INFINITE GROUND
Sang-Bin Rhee (Ph.D. Thesis) 1967 238 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 67-17835

Circular flat discs and hemispheres were used for the finite ground planes. Experiments were conducted over a 6 to 1 frequency range, with the length of monopole antenna fixed at a quarter wavelength at the upper end of the frequency band. The radii of finite ground planes used for experiments were generally less than a quarter wavelength. Input impedances were measured as a function of frequency at the base of the antenna, using as variables the radius and the locations of the ground plane with respect to an infinite ground below. Scale models were used to obtain measurements of radiation patterns and antenna current distributions. These measurements are presented graphically. A theoretical analysis is also made of a monopole with a hemispherical ground plane on an infinite ground. Far-zone electromagnetic fields were calculated as a function of both the ground plane radius and the frequency. Radiation resistances were also calculated.

N68-36676 Stanford Univ., Calif.
BISTATIC-RADAR IMAGING AND MEASUREMENT TECHNIQUES FOR THE STUDY OF A PLANETARY SURFACES
George Leonard Tyler, Jr. (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17519

The problem of imaging a planetary surface is considered from the point of view of continuous wave bistatic-radar in which transmissions originating on the Earth (or on a spacecraft) would be received on a spacecraft (or on the Earth) after reflection from a planetary surface. Using a superposition model the ordinary brightness distribution, the differential radar cross-section, the polar scattering diagram, and the radar albedo of a surface are all related

measures of the local surface properties. The surface brightness distribution may be determined by cross-correlating the scattered fields with the expected signal from each point on the surface. Physical analogs of the process exist as modifications of holograms and synthetic antenna arrays. The maximum-likelihood estimator for the brightness of a specific scattering area, in the presence of white Gaussian noise at low input signal-to-noise ratios, is a Hilbert quadratic form with the expected autocorrelation function of the signal from the scattering area as a kernel. Dissert. Abstr.

N68-36729*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

NONLINEAR ESTIMATION WITH QUANTIZED MEASUREMENTS: PCM PREDICTIVE QUANTIZATION, AND DATA COMPRESSION

Renwick E. Curry Aug. 1968 44 p refs

(Grant NsG-254)

(NASA-CR-97197; RE-45) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Statistics conditioned on quantized measurements are considered in the general case. These results are specialized to Gaussian parameters and then extended to discrete time linear systems. The conditional mean of the system's state vector may be found by passing the conditional mean of the measurement history through the Kalman filter that would be used had the measurements been linear. Repetitive use of Bayes' Rule is not required. Because the implementation of this result requires lengthy numerical quadrature, two approximations are considered: the first is a power series expansion of the probability density function; the second is a discrete time version of a previously proposed algorithm which assumes that the conditional distribution is normal. Both algorithms may be used with any memory length on stationary or nonstationary data. The two algorithms are applied to the noiseless channel versions of the PCM, predictive quantization, and predictive-comparison data compression systems. Author

N68-36765# New Mexico State Univ., University Park. Physical Science Lab.

S-BAND TELEMETRY ANTENNA STUDIES: SOUNDING ROCKET RESEARCH AND DEVELOPMENT PROBLEMS

Bruce T. Buller Mar. 1968 141 p refs

(Contract AF 19(628)-5923)

(AFCRL-68-0331; SR-2; AD-673377)

The report was prepared to promote mutual understanding between professional disciplines involved in the use of the research vehicles. In order to achieve this understanding, the major problems with some possible solutions are presented. The problems and solutions presented are approached with a 100 percent telemetry data acquisition probability philosophy. Two basic problems evolving from the shift from VHF to S-band are shadowing and interference effects, which appear when vehicle wavelength-to-diameter ratios are less than one. Besides these two, other problems arise which increase the difficulty of developing suitable antenna designs. These include the electromagnetic properties of antennas, vehicle geometric shapes, antenna-vehicle integration, vehicle trajectories and overall telemetry system performance. Some conceptual antenna system designs have been proposed and investigated. Two of these systems have proven feasible, a nose-tip mounted system and a cavity mounted system. However, the two systems designs will not solve all the problems in achieving suitable radiation patterns for all vehicle mission requirements. Since development of S-Band antennas for all aspects of vehicle telemetry use is a relatively recent task, many of the problems are being encountered for the first time, and therefore do not have ready and economical solutions. Author (TAB)

N68-36773*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AUTOMATED GROUND STATION SOFTWARE DEVELOPMENT

John C. Rodgers Oct. 1967 87 p refs

(NASA-TM-X-63335; X-521-67-492) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Systems analysis, total system design, program development and coding, and program testing are described for prototype automated ground station software that can control four ground station tracking links by a single computer. Fifteen tracking station functions were identified as operational requirements of the computer system; and these functions are performed in the prepass, pass, postpass, and off-line modes. The program is a joint effort between various groups involved in STADAN tracking and those at the Network Test and Training Facility at Goddard Space Flight Center. Details are given for an automated multifunction receiver, and a block diagram is included for the computer on order for automated station use. This has a .850 μsec cycle time, multiple memory banks (6max) permitting independent operation of the central processor and input-output processors (6max), 24 million bit fixed-head disk memory, 3 tape systems, and expandable priority interupts (240max). M.W.R.

N68-36801# Mitre Corp., Bedford, Mass.

DIFFRACTION OF PROGRESSING WAVES BY EDGES

R. M. Lewis May 1968 39 p refs

(Contract AF 19(628)-5165; Arpa Order 596; Proj. Defender)

(MTR-497; ESD-TR-67-628; AD-673353)

For high frequency monochromatic waves the geometrical theory of diffraction can be used for predicting radar scattering. For typical targets the strongest returns, due to speculars, occur only at special aspect angles. At most aspect angles the dominant returns are usually due to diffraction by the "edges" of the target. The proposed use of short pulse radars requires the consideration of scattering by non-monochromatic signals. The progressing wave formalism is a generalization of the geometrical theory of diffraction suitable for treating pulses for which the high frequencies predominate. This paper extends the earlier work on specular scattering of progressing waves to include scattering by edges. For a moving target, partial results are obtained. Author (TAB)

N68-36811# Oklahoma State Univ., Stillwater. Sandia Corp., Albuquerque, N. Mex. School of Electrical Engineering.

OPTIMUM SAMPLING METHODS Final Report

Arthur M. Breipohl, John C. Hooker, and William C. McCormick, Jr. Aug. 1967 118 p refs Sponsored by AEC Prepared for Sandia Corp.

(SC-CR-67-2752) CFSTI: HC $3.00/MF $0.65

A method of modeling a time varying population is described. This allows construction of an optimum sampling size that can be described by decision theory formulation. The modeling method suggests a way of incorporating the results of component tests and variables information to predict degradation. It is suggested that the sequential sampling method may be useful in production acceptance sampling. The FORTRAN program is given; sample inputs and outputs are shown. NSA

N68-36815# Lincoln Lab., Mass. Inst. of Tech., Lexington.

PARALLEL CHANNELS WITHOUT CROSSTALK

Joel May Aug. 1968 113 p refs

(Contract AF 19(628)-5167)

(TR-447; AD-673479)

In this report, a study is made of information theoretic channels which are decomposable into a number of parallel subchannels

which will, in general, be dependent. For this situation, two models are constructed in which each subchannel input affects only the corresponding subchannal output (no crosstalk). In the first model (MC channel), the lack of crosstalk is ensured by constraints on the channel conditional probability distribution. The second model (MS channel) is a channel with an underlying state structure with states independent of the input. Both models are memoryless. All MS channels are MC, but the reverse does not hold. The effect of subchannel dependencies on capacity and random coding exponent (RCE) is investigated. It is proved that these dependencies cannot decrease the capacity of our channels. However, subchannal dependencies may either increase or decrease the RCE. It is also proved that the capacity of the channel is not less than the sum of the capacities of the individual subchannels. When the state model is used, the above two quantities are equal if the receiver has knowledge of the channel state. A definition of partial state knowledge is given. It is proved that, when the receiver has partial state knowledge, the resulting capacity and RCE are not decreased. For complete state knowledge at the receiver, the capacity and RCE are not less than those obtained for partial state knowledge. Various coding alternatives are discussed, and formulas are given for computing or bounding performance. Author (TAB)

N68-36870*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A PROGRAMMED MATHEMATICAL MODEL TO SIMULATE THE BENDING OF RADIO WAVES IN ATMOSPHERIC PROPAGATION

B. Rosenbaum and N. Snow May 1968 19 p refs

(NASA-TM-X-63365; X-551-68-367) CFSTI: $3.00 CSCL 20N

The ray path of an RF signal undergoes bending in the interval of atmospheric propagation between a satellite and earth-based tracking station. Resultant refraction is a perturbation on observed elevation angles and Doppler shifted signals. As a practical tool for the computation of corrections a mathematical model simulating the tracing of the refracted ray path has been programmed for use by the Goddard Space Flight Center computer facilities. Author

N68-36896# Washington Univ., Seattle. Dept. of Electrical Engineering.

THE EFFECT OF SCANNING ON THE IMPEDANCES OF FINITE BROADSIDE, COLLINEAR, AND RECTANGULAR ARRAYS

Akira Ishimaru and Stanley Lau-Powu Apr. 1968 51 p refs

(Contract AF 19(628)-5879)

(AFCRL-68-0317; TR-121; SR-5; AD-673358)

The paper presents a study of the variations of the dipole impedance in broadside, collinear, and rectangular arrays as functions of scanning angle. The formulation is based on simultaneous intergral equations for currents, and the current distributions are represented by two even terms and one odd term. Three matrix equations are solved for the coefficients of currents and impedances and radiation patterns are calculated. For broadside array, from the edge toward the center. The impedance exhibits circular to almost straight behavior in impedance plot. For collinear array, the impedance for spacing close to a half wavelength shows a large circular rotation to a smooth straight line behavior in the impedance plane for the dipole location from the edge to the center elements. The impedance for the large spacing is close to that of a single dipole. They are also compared with that of infinite arrays. The effect of these mutual couplings on the radiation patterns is also illustrated. Author (TAB)

N68-36912# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany).

THE ACQUISITION OF RESEARCH ROCKETS ON THE CLIMB BY PRE-SETTING THE RADAR

W. Müschler Paris ESRO Jan. 1968 19 p

(ESRO-SN-71) CFSTI: HC $3.00/MF $0.65

The high initial speed of rockets makes it extremely difficult to track them from the moment of launching. One possible solution would be to guide the radar by optical means until radar acquisition is achieved but this can be frustrated by poor seeing conditions. Another solution towards early acquisition would be pre-setting the radar to a specific altitude. The present paper gives a geometrical treatment of the problem, as it applies to the Kiruna range. In selecting the height at which the radar is to be pre-set, a compromise has to be reached between the height of the useful zone to be covered and the intensity of the radar echoes being returned. Author (ESRO)

N68-36981# Technische Hochschule Hannover (West Germany).

A CONTRIBUTION FOR OPTIMIZATION DEMODULATION OF DISTURBED FREQUENCY MODULATION SIGNALS [EIN BEITRAG ZUR OPTIMALEN DEMODULATION GESTORTER, FREQUENZMODULIERTEN SIGNALE]

W. Schmueckle (Ph.D. Thesis) 1967 113 p refs In GERMAN

CFSTI: $3.00

The demodulation of a frequency modulated signal with noise by a phase-lock-loop system or a frequency resonant demodulator was studied. Various noise interference probabilities were analyzed and a mathematical model for Gauss noise was used to develop an optimal filter for the demodulation process. It was shown that the phase-lock-loop system performed better at larger signal to noise ratios; its functional limit was at about 1 dB signal-to-noise ratio; functional limit for the frequency resonant demodulator was at about 8 to 10 dB for the same signal. Transl. by G.G.

N68-37023*# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences.

PREDICTION OF TROPOSPHERIC RADIO TRANSMISSION LOSS OVER IRREGULAR TERRAIN: A COMPUTER METHOD, 1968

A. G. Longley and P. L. Rice Jul. 1968 139 p refs

(NASA Order R-68)

(NASA-CR-97275; ERL-79-ITS-67) GPO: HC $0.70; CFSTI: MF $0.65 CSCL 17B

A computer method is described for predicting long term median transmission loss over irregular terrain. The method is applicable for radio frequencies above 20 MHz and may be used either with detailed terrain profiles for actual paths or with profiles that are representative of median terrain characteristics for a given area. Estimates of variability in time and with location, and a method for computing service probability, are included. Author

N68-37132# European Space Technology Center, Noordwijk (Netherlands).

ERRORS IN THE POSITION IN ORBIT OF ESRO 1 AND ESRO 2 SATELLITES DUE TO THE ERRORS IN THE TRACKING MEASUREMENTS

N. L. S. Reeder Paris ESRO Aug. 1968 26 p refs

(ESRO-TM-18(ESTEC)) CFSTI: HC $3.00/MF $0.65

For the orbits of ESRO I and ESRO II, a comparison is made of the errors in calculated positions of a satellite for various station networks. These networks were chosen to show: the effect of the move of the CNES station from Hammaguir to a site in French Guiana; the advantage of using telemetry aerial pointing data; and the results from using ESRO data only. Author (ESRO)

N68-37150# European Space Technology Center, Noordwijk (Netherlands).

THE TELEMETRY STATION AT MONTE CARDIGA, SARDINIA

G. E. N. Scoon Paris ESRO Apr. 1968 78 p refs
(ESRO-TN-25(ESTEC)) CFSTI: HC $3.00/MF $0.65

A guide to users and potential users of the Monte Cardiga telemetry station, which is associated with the Italian sounding-rocket range at Salto di Quirra, Sardinia. After a brief account of the terms under which ESRO is allowed the use of the range, a short history of the telemetry station is given. This is followed by a detailed description of the equipment installed at the telemetry station, including the two ESRO-owned high gain antenna systems (the Automatic Tracking Telemetry Receiving Antenna (ATTRA) system and a manually steered Yagi array). The capabilities and the degree of flexibility of the telemetry system are indicated. There are two appendices, comprising: a note on the utilization of the station, with reproductions of telemetry log and calibration sheets; and detailed specifications of some of the equipment. Author (ESRO)

N68-37208*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

SPECTRAL STUDIES OF SIGNALS PRESENT IN THE COMMAND AND COMMUNICATIONS SYSTEM UP-LINK TRANSMITTER

R. D. Wetherington and J. R. Walsh, Jr. 1 Jul. 1967 159 p refs
(Contract NAS8-20054)
(NASA-CR-98033; TR-3) CFSTI: $3.00 CSCL 17B

Results are described of an investigation to derive mathematical methods for calculating the frequency spectrum at several points of interest in the Saturn 5 command and communications system, and of implementing these methods on a digital computer so that the various spectra could be obtained. Methods are presented for the calculation of the baseband spectrum of the biphase modulated command data signal, the baseband spectrum of the range code, the spectrum produced by the frequency modulated command data subcarrier generator, and the spectra of the phase modulated S-band carrier for various modulating signals. The S-band spectra were obtained for input signals to the phase modulator which consisted of (1) the frequency modulated output of the command data subcarrier generator when modulated with the baseband command data signal, (2) the range code signal, and (3) the range code signal and the unmodulated command data subcarrier. Results of all of the spectral calculations were compared with measured values obtained in the laboratory and good agreement was obtained. Computer programs written in ALGOL for the Burroughs B 5500 computer are included, as well as printouts of sample calculations. Author

N68-37210*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXPERIMENTAL INVESTIGATION OF AN ADAPTIVELY PHASED LARGE APERTURE ARRAY AT VHF

Leonard F. Deerkoski Jul. 1968 55 p refs
(NASA-TM-X-63360; X-525-68-139) CFSTI: HC $3.00/MF $0.65
CSCL 09F

A two element adaptively phased array operating at 136 MHz and using the APDAR receiver as the coherent combiner is evaluated. The measured SNR improvement capability of this space diversity system during active satellite experiments is presented. The measured relative phase between the antennas and representative spectra of these data are also given. Author

N68-37234 Michigan Univ., Ann Arbor.

ANALYSIS OF AN APERTURE ANTENNA SYSTEM LOADED WITH AN INHOMOGENEOUS DIELECTRIC

Jesse Samuel Bitler (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17726

An analysis is made of an aperture system loaded with an inhomogeneous dielectric. The system consists of two parts. The first part is a section of rectangular waveguide extending from negative infinity along the z-axis to a distance z_0 back from an infinite, perfectly conducting ground plane, whose normal is also in the z direction. This section of waveguide is filled with a homogeneous dielectric. The second part is a section of rectangular waveguide of the same dimensions extending from z_0 to an aperture in the ground plane. This section of waveguide is filled with an inhomogeneous dielectric. The dielectric is characterized by a permeability and permittivity that varies exponentially with distance from the aperture. Aperture power reflection coefficient versus degree of inhomogeneity was calculated for various frequencies and values of aperture permeability and permittivity. Dissert. Abstr.

N68-37287 Missouri Univ., Columbia.

CURVILINEAR ANTENNA—ARRAYS

Bing A. Chiang (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-288

Field patterns are found for arrays with varied number of elements, different sizes and shapes (circular-arc and sine arrays are the two considered here, because of the simplicity in their forms), and the various combinations of inter-element spacings. The results are grouped and analyzed. Unusual results like ripplelss sidelobes, broad beams, Tchebycheff like beams are discussed. The dynamic programming technique is used in the pattern synthesis of sine arrays, which could as well be any other shape, and results are found to be very satisfactory. A series-integral form of curvilinear array pattern function is discussed. Knowing the principle of stationary phase approximation, an element position perturbational technique is developed for circular arc arrays, and results in high intensity beams. Curvilinear arrays show the promise of simplicity in synthesis, and have a much wider selection of field patterns than linear arrays. Dissert. Abstr.

N68-37295 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.

ULTRASONIC DELAY LINES FOR THE PAL COLOUR-TELEVISION SYSTEM

F. T. Backers (Ph.D. Thesis—Tech. Univ., Eindhoven) 1968 85 p refs *Its* Res. Rept. Suppl. no. 9

This supplement deals mainly with ultrasonic delay lines which are used in Phase Alternation on Line (PAL) colour television receivers for delaying chrominance signals. The requirements which a PAL delay line must satisfy, are derived. Such a delay line has been developed; it can be characterized as a shear wave folded-space delay line with ceramic piezoelectric transducers, having an offset angle for suppression of the third-time-round signal. The phase-delay variation with temperature must be extremely small. The propagation body is therefore made of a glass specially developed for this purpose. A discussion is given of alternative designs. A relation between various delay-line parameters and external circuit parameters is derived which, if complied with, produces the maximum obtainable bandwidth. Numerically computed transducer pair amplitude and phase frequency characteristics are given for a number of parameter values. The reflection coefficient at the junction between propagation medium and transducer has also been numerically computed for a number of cases. A discussion on the methods of measuring the main electrical characteristics is included. Author

N68-37297*# American Science and Engineering, Inc., Cambridge, Mass.

APOLLO SCIENTIFIC DATA SYSTEM (T4/S17) Qualification Test Report

1 Dec. 1966 104 p
(Contract NAS9-4841)
(NASA-CR-92324; ASE-1740) CFSTI: $3.00 CSCL 09F

Results are presented of the environmental qualification tests performed to verify the inherent capability of the design of the T4/S-17 Apollo scientific data system. Discussions are given of the testing philosophy, and descriptions are presented of the test methods and equipment. Test areas covered include post environment operational verification, environmental operation, data handling, VDU tests, compartment A low temperature tests, and data handling system low temperature tests. C.T.C.

N68-37330*# Melpar, Inc., Falls Church, Va.
RESEARCH, DEVELOPMENT, DESIGN, INTEGRATION AND TESTING OF THIN FILM PERSONAL COMMUNICATIONS AND TELEMETRY SYSTEM (TFPCTS) Final Report
Oct. 1968 135 p
(Contract NAS9-3924)
(NASA-CR-92323) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Integration and testing of a thin film personal communications and telemetry system are reported. Brief summaries are included of previous phases which consisted of (1) a research program of applicable device materials and the development of an ultrahigh frequency thin film device, and (2) the fabrication of function circuit blocks with the development device and existing thin film devices to produce the telemetry system. The major parts of the system are the telemetry unit, dual transmitter, dual receiver, dual diplexer, dc power supply, mode switch, coaxial relay, and mother P.C. board. Minor parts include the multiple pin connector for dc and audio frequency signals, coaxial antenna connector, a 20K ohm potentiometer used for volume control for the two receivers, a mounting clamp and shim for the coax relay, and the package enclosure. C.T.C.

N68-37335 Bolkow Entwicklungen K. G., Munich (West Germany).
AN AERODYNAMICALLY FAVORABLE ANTENNA FOR ROCKETS [EINE AERODYNAMISCH GUENSTIGE ANTENNE FUER RAKETEN]
Dieter Jaeger 26 Sep. 1967 22 p In GERMAN Presented at the Conf. of Antennas and Electromagnetic Fields, Darmstadt, West Ger., 17–20 Oct. 1967
(EP-92-O) CFSTI: $3.00

Reviewed are electromagnetic properties, radiative patterns, and optimal construction aspects of a compact, short rocket antenna. Also discussed are characteristic measurement and data reduction methods for onboard antenna technologies. Author

N68-37384*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESULTS FROM THE EVALUATION OF TRACKING SYSTEM MEASUREMENT ERRORS ON THE APOLLO-SATURN 201-204 FLIGHT TESTS
Bobby G. Junkin 19 Jul. 1968 95 p refs
(NASA-TM-X-53756) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The TEMS Multiple Regression Analysis Method for postflight tracking system error model analysis is used to evaluate measurement errors on the Apollo-Saturn IB flight test data. The concept of least squares adjustment with parameter constraints is involved in the evaluation process. A stepwise regression procedure is used in conjunction with the TEMS method to establish truncated tracker error models for the AS-204 tracking radars. The guidelines for these models show considerable usefulness in constructing models containing the most significant variables. An overall summary of results obtained on the AS-201 through AD-204 flight tests shows that the standard deviations for several of the error model coefficients do not vary significantly from test to test or from radar to radar. Author

N68-37417*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 203–294 refs (See N68-37397 23-11)

Research in the following areas is reported: coding and synchronization; combinatorial communication; propagation; communications systems development; information processing; astrometrics; and data compression techniques. Cited are studies of: (1) the variance of scattering-law estimates; (2) a digital demonstration of sequential decoding and comparison with block-coded systems; (3) disjoint cycles from the de Bruijn graph; (4) pulsar observations; (5) product entropy of Gaussian distributions; and (6) the maximum indices of comma freedom for the high-data-rate telemetry codes. S.C.W.

N68-37418*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 295–309 refs (See N68-37397 23-11)

Communications elements research is reported which focuses on studies of (1) switching frequency determination for the Nodding Subdish System; (2) microwave thermal noise standards; (3) RF breakdown in coaxial transmission lines; and (4) the 400-MHz coaxial cavity radiator. S.C.W.

N68-37419*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT TELEMETRY AND COMMAND
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 310–313 refs (See N68-37397 23-11)

The multiple-mission telemetry system (MMTS) bit tracking and detection functions are accomplished by means of a mission-dependent program in the TCP computer. In the original demonstration and Mariner Mars 1969 versions of this program, and estimate of the ratio of energy per bit to noise spectral density (ST/N_o) is used as an in-lock indicator. The threshold value of ST/N_o is entered via typewriter and is a function of the expected ST/N_o. Described is the approach used in evaluating the ST/N_o estimator as a lock detector. Also reported is the initiation of a study focusing on the design and test of telemetry modulation systems for relay-link applications, such as between a planetary entry capsule and a nearby orbiting or flyby spacecraft. Discussed are continuing breadboard evaluation studies of a proposed relay link for a Mariner 1971-type mission. S.C.W.

N68-37420*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 314–334 refs (See N68-37397 23-11)

Based on continuing studies focusing on the development of surface imaging or mapping radar systems applicable to lunar and planetary missions, preliminary studies have shown that the S-band ranging transponder with a high gain antenna could serve as a side-looking radar. To demonstrate this idea, an experiment was performed using the S-band ranging transponder and high gain antenna of the Lunar Orbiter V spacecraft in flight. A description of the experiment and the derivations of the mapping equations are presented. General results from an independent study of power spectral densities for binary frequency shift keyed waveforms are also reported. S.C.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-36119 California Univ., Berkeley.
COMPUTER REPRESENTATION, GENERATION, AND MANIPULATION OF GRAPHICAL INFORMATION
Gary Dean Hornbuckle (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-81

This thesis describes a computer, called a picture generator, especially designed for processing graphic information. The machine language is a form of compiled LISP with data and program therefore represented as LISP tree-structures. The topology and picture information occur in the same structure, and intermediate forms usually found in graphic systems are not necessary. Recursion and nesting required for LISP are implemented with instructions whose operands are pushdown stack pointers. The picture generator is designed with microprogrammed control and interfaces to a primary memory which is shared with other processors. Included in the processor are analog circuits for generating lines and symbols on cathode ray tube displays, and graphic input devices such as RAND tablets or lightpens provide input. With a 100 nanosecond read-only memory (ROM) for the microprogram, a 12-bit multiply or divide is performed in 4 microseconds and symbols are generated from data stored in the ROM in 7 microseconds. Dissert. Abstr.

N68-36167 Saskatchewan Univ., Saskatoon.
THIN MAGNETIC FILM STORAGE DEVICES
Andrew Charles Tickle (Ph.D. Thesis) 1967 277 p
Available from Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 67-15425

Binary information may be represented by domains in a thin uniaxial magnetic film. By means of suitable sequences of applied fields domains may be propagated to a point where their data-representing state may be detected. The characteristics of devices working on the principle have been investigated for different modes of operation. The nucleation and subsequent morphology of domains has been studied with particular regard to the modes in which spurious changes occur. The operating tolerances on the magnetic driving fields depend on the difference between H_e, the field required to nucleate domains, and H_0, the field required to move domain boundaries. H_0 corresponds to the anisotropy field, H_k. By increasing the uniaxial anisotropy, H_k may be considerably increased. H_0 may be controlled independently by varying the film thickness. Spurious changes in the data representing states of domains are caused by magnetostatic interactions during relaxation of the domains after the driving field pulses terminate. These magnetostatic effects may be modified by a magnetic biassing field. Dissert. Abstr.

N68-36262# Illinois Univ., Urbana. Dept. of Computer Science.
SOME NEW RESULTS ON RESOLUTION IN AUTOMATED THEOREM PROVING
Lawrence J. Henschen (M.S. Thesis) 1 May 1968 26 p refs
(Grant NSF-GP-4836)
(Rept.-261; PB-178729) CFSTI: HC $3.00/MF $0.65

The document deals with automatic means of obtaining proofs of mathematical theories. USGRDR

N68-36278# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONIC DIGITAL COMPUTER SIMULATION OF ONE METHOD OF CHARACTER RECOGNITION [MODELIROVANIE NA ETSVM ODNOGO METODA OPOZNAVANIYA OBRAZOV]
A. M. Kukinov and V. S. Fain Sep. 1967 18 p refs Transl. into ENGLISH from Probl. Peredachi Inform. (Moscow), no. 18, 1964 p 48–58
(FTD-HT-67-332; AD-673839)

The paper describes an experimental verification of the method of pattern recognition developed earlier by the author. One thousand projections, collected at random from photographs, were sampled. On the basis of this sampling, all the stages of the recognition process were modeled. The method of calculating the standard deviation of the significant features is described as well as the algorithms used for modeling the recognition process. A comparison of the experimental results obtained with the results calculated by theoretical formulas has shown that the latter differ by a factor not exceeding 1.5 and this is considered to be a good agreement for the problem examined. TAB

N68-36319*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.
DOCUMENTATION OF WIRING HARNESSES BY USE OF PUNCHED-CARD TECHNIQUES
W. G. Kloezeman and W. W. Hicks 15 Oct. 1968 18 p
(Contract NAS7-100)
(NASA-CR-97150; TR-32-1326) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This report discusses a technique for using a punched-card printer to produce wiring harness documentation. A format for punching the required information on the cards and a method for sorting the resulting cards in preparation for printing are covered. Also, the printing format and the wiring of the printer control panel are discussed. Author

N68-36418*# Martin Co., Orlando, Fla.
FLUIDIC DECODER AND DISPLAY DEVICE
Jacq van der Heyden Sep. 1968 92 p
(Contract NAS12-532)
(NASA-CR-86105) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The feasibility of the fluidic decoder and display device for use on board a spacecraft is demonstrated. This system may be used in place of the relay-type hardware planned for this operation. The advantages of the fluidic decoder and display device are that it conserves power sources by operating with available gases normally found in a space system and it provides a longer life expectancy than electroluminescent displays. Author

N68-36438*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
COMPUTER-AIDED DESIGN AND ANALYSIS OF CIRCUITS AND SYSTEMS Final Report, 20 Sep. 1966–1 Jul. 1968
Eugene W. Henry 1 Jul. 1968 30 p refs
(Grant NGR-15-004-021)
(NASA-CR-97122; TR-EE-686) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Details are reported on the consolidation of computer program routines associated with computer-aided design and analysis of circuits and systems. A standard format description was developed to simplify use and aid in standardization of programs. Applicability of a network analysis program to non-electronic problems was

demonstrated. The program library was developed to provide transfer functions, transient responses, frequency responses, root locus plots, and digital simulation of continuous systems. The routines were employed as integral parts of electrical engineering courses and laboratory work. The library capability was augmented by a circuit performance sensitivity routine. D.H.B.

N68-36444# Stanford Univ., Calif. Dept. of Computer Science.
FORMALIZATION OF PROPERTIES OF PROGRAMS
Zohar Manna Jul. 1968 22 p refs
(Contract ARPA SD-183)
(AI-MEMO-64; AD-673433)

Given a program, an algorithm will be described for constructing an expression, such that the program is valid (i.e., terminates and yields the right answer) if and only if the expression is inconsistent. Similar result for the equivalence problem of programs is given. These results suggest a new approach for proving the validity and the equivalence of programs. Author (TAB)

N68-36474# Massachusetts Inst. of Tech., Cambridge.
CARPS. A PROGRAM WHICH SOLVES CALCULUS WORD PROBLEMS
Eugene Charniak (M.S. Thesis) Jul. 1968 66 p refs
(Contract Nonr-4102(01))
(MAC-TR-51; AD-673670)

CARPS (Calculus Rate Problem Solver) is a program written to solve calculus word problems, but is restricted to rate problems. The overall plan of the program is similar to Bobrows STUDENT, the primary difference being the introduction of structures as the internal model in CARPS. Structures are stored internally as trees. Each structure is designed to hold the information gathered about one object. A description of CARPS is given by working through two problems, one in great detail. Also included is a critical analysis of STUDENT. Author (TAB)

N68-36482# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A CORRELATION PERCEPTION METHOD [O KORRELYATSIONNOM METODE RASPOZNAVANIYA]
V. A. Kovalevskiy 15 Sep. 1967 19 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Chitayuschiey Avtomaty i Raspoznavaniya Obrazov (Kiev), 1965 p 46-61
(FTD-HT-23-504-67; AD-673749)

In recognizing optical patterns, uniform variations of the average brightness and contrast can be used as permissible transformations. In the correlation method of pattern recognition, one standard picture is established for each situation to be recognized. From this standard, a number of transformed standards are obtained. Then, the factors of the correlation of this picture with each transformed standard may be calculated, and the maximum correlation factor may be selected. An experimental corroboration with 35000 typed numerals and a computer simulation is mentioned. TAB

N68-36570# General Motors Corp., Santa Barbara, Calif. Sea Operations Dept.
DIGITAL COMPUTER ROUTINES FOR POWER SPECTRAL ANALYSIS
Rex P. Brumbach Jul. 1968 128 p refs
(Contract Nonr-4298(00); Proj. Vela Uniform)
(TR68-31; AD-673859)

This report presents FORTRAN IV source program listings for 8 routines of general use in power spectral density analyses on a digital computer. Included are a Fast Fourier Transform (FFT) routine, power density function routine via the FFT, and data messaging routines. Mathematical derivations and manipulative techniques of deterministic spectral analysis theory for sampled data are set forth in detail. Author (TAB)

N68-36584# Postmaster-Generals Dept., Melbourne (Australia). Research Labs.
STRIP-CHART TO PUNCHED TAPE TRANSLATOR
G. F. Jenkinson 28 Oct. 1966 19 p
(NP-17501; Rept.-6075)

A strip chart translator was developed to convert complex strip chart records (for example, those obtained from radio propagation tests) into digital format, on punched tape, to allow analysis by electronic computer. An operator is required to follow the chart trace with a cursor mark, but the translation process is otherwise automatic. The detail contained in such record traces has so far precluded the use of a fully automatic translation process. Author (NSA)

N68-36601# California Univ., Livermore. Lawrence Radiation Lab.
COMPLEX ON THE 3600
D. T. Warren 17 Feb. 1967 47 p
(Contract W-7405-eng-48)
(UCID-15244) CFSTI: HC $3.00/MF $0.65

The computer program COMPLEX, a least squares method for fitting quadratically interpolated tables to a two dimensional data array, is reorganized for use in the CDC 3600 computer. COMPLEX is used to compute values of a function, such as energy or pressure, as a function of two variables. NSA

N68-36673 California Univ., Los Angeles.
ORDERINGS ON STOCHASTIC SEQUENTIAL MACHINES
Theodore Tsoong-Tai Nieh (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-802

By decomposing a stochastic machine into a state-equivalent deterministic machine having an additional channel of random inputs, a measure of complexity (which has significance with respect to actual realization) based on which machines of a given class can be ordered is defined. The measure of complexity has more meaning than the number of states when considering the problem of actual realization of a given stochastic sequential machine with physical components. Each machine is considered from a utility point of view by establishing a hierarchy of performance criteria through assigning numerical values to each input and output symbol respectively. The main endeavor consists of: (1) the determination of necessary and/or sufficient conditions when one machine is better than the other within a certain class so as to obtain an *ordering* among machines in this class with respect to each specified performance criterion; and (2) the study of the interplay and relation between the various specified performance criteria. Dissert. Abstr.

N68-36695# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A LANGUAGE FOR DESCRIBING AND MODELING DIGITAL STRUCTURAL SYSTEMS (TSMIOD) [YAZYK DLYA ZAPISI I MODELIROVANIYA RABOTY TSIFROVYKH STRUKTURNYKH SK EM (TSIMOD)]

Kh. Salum 12 Sep. 1967 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz.-Mat. i Tekhn Nauk (Tallinn), no. 3, 1965 p 464–471
(FTD-HT-67-204; AD-673811)

Lately, considerable attention has been paid to the automation of the design of digital computers and in particular to the formulation of languages and approaches to the modeling of the operation of the existing as well as of future schemes. A universal language established for the modeling of the existing digital computers would avoid the necessity for the creation of a new modeling program each time a new digital scheme is being developed. The new proposed language TsIMOD differs from the previously known by viewing an arbitrary digital scheme as being controllable by microprograms; this makes the new language more universally applicable. The present paper presents a brief semantic description of the language and describes its syntax by a structural diagram. The approach is illustrated on the case of the description of a small computer similar to the M-3. An interpreting program of the M-20 computer contains 2,000 cells in addition to 200 operating cells and constants. The description of the structural scheme of the computer occupies 240 cells. The time of modeling of a single command is on the average equal to 1.5 sec. TAB

N68-36696# California Univ., Berkeley. Lawrence Radiation Lab.
A DATA LINK BETWEEN SMALL COMPUTERS AND A CDC 6600
Sypko W. Andreae and Robert W. Lafore, Jr. 26 Oct. 1967 9 p Presented at the 14th Nucl. Sci. Symp., Los Angeles, Calif.
(Contract W-7405-ENG-48)
(UCRL-17622; CONF-671026-11) CFSTI: HC $3.00/MF $0.65

A data link system which connects small computers (mostly PDP5's and PDP8's) operating on-line with high-energy physics experiments to a CDC 6600 computer at LRL is described. The small computer provides data acquisition and simple checks on the experiments while the CDC 6600 provides final analysis of the data. NSA

N68-36712# Rand Corp., Santa Monica, Calif.
COMPUTER SOFTWARE: THE EVOLUTION WITHIN THE REVOLUTION
George W. Armerding Jul. 1968 15 p
(P-3894; AD-673333)

The cost of developing and maintaining the software for current computers has approached, perhaps exceeded, the cost of developing, manufacturing, and maintaining the hardware on which that software runs. Within the ranks of computer users, we are beginning to hear rumblings that manufacturers should price all of their software separately. Then the customer can go down the price list and pick out–and pay for–only the items he needs. Author (TAB)

N68-36714 RAND Corp., Santa Monica, Calif.
PROGRAMMING BY QUESTIONNAIRE: AUXILIARY PROGRAMS
Patricia L. Love and Paula M. Oldfather Aug. 1968 81 p refs
(Contract F44620-67-C-0045)
(RM-5689-PR; AD-673834) Available from the RAND Corp., 1700 Main Street, Santa Monica, Calif. 90406: $3.00

Description and listing of five small SIMSCRIPT and FORTRAN programs to complete the documentation of Programming by Questionnaire, a technique for reducing the time and cost of preparing large computer programs. Three housekeeping programs, CHKOUT, LOCATE, and KORCT, serve to check, correct, and maintain the program generator deck. The CHKOUT program checks the deck for logical consistency and provides other information essential for correcting and maintaining it. The LOCATE program finds specified cards within the deck, which is very large. The KORCT program makes corrections to the deck and checks to see that it is in order. The JHIST and RHIST programs analyze the results of a JSSPG simulator. JHIST provides a complete history of the jobs in the simulated job shop, and RHIST provides a history of the resources. Author (TAB)

N68-36720# RAND Corp., Santa Monica, Calif.
COMPUTATIONAL LINGUISTICS: BIBLIOGRAPHY, 1967
David G. Hays, Bozena Henisz-Dostert, and Jean I. Houston Jul. 1968 68 p refs
(Contract F44620-67-C-0045)
(RM-5733-PR; AD-673474)

A selective, unannotated listing of 664 U.S. and foreign publications that became available in 1967 relevant to the fields of computational linguistics and documentation. The listing includes books, articles, reports, and conference papers. There is selective coverage of classification techniques, computation and programming, with some attention to automata theory, computers and hardware, and social science text-processing by computer. The Documentation heading covers bibliographies, library catalogs, information systems, and publication systems. Computational Linguistics is divided into decoding and encoding; glossaries; machine translation; parsing; synthesis; and text files. Linguistics is subdivided into specific languages, especially English and Russian; algebraic syntax; research methods; and semantics. Arrangement is by subject, with indexes by author and by authors organizational affiliation (if given). The index by countries includes 109 U.S. organizations, including 14 Federal Government agencies, and 87 organizations in other countries. Author (TAB)

N68-36721# Michigan Univ., Ann Arbor. Systems Engineering Lab.
MATHEMATICAL MODELS OF INFORMATION SYSTEMS Technical Report, Oct. 1966–Oct. 1967
Harvey L. Garner Griffiss AFB, N. Y. RADC Jul. 1968 87 p refs
(Contract AF 30(602)-3548)
(RADC-TR-68-260; AD-673386)

The report summarizes several investigations in the development of mathematical models of information processing systems. Particular attention is given to the following: algorithm complexity, algorithms with the algebraic complexity for solving the degree constrained subgraph problem, a study of the Shannon switching game, algorithms for the analysis of finite state machines, existence theorems for the realization of finite automata by iterative networks, associative processors, isomorphism invariance of sequential machines, graph theory models of parallel computation, and a probabilistic analysis of sequential machine decomposition. Author (TAB)

N68-36787# Bell Aerosystems Co., Buffalo, N. Y.
A DIGITAL COMPUTER PROGRAM FOR DERIVING OPTIMUM NUMERICAL INTEGRATION TECHNIQUES FOR REAL-TIME FLIGHT SIMULATION Final Report, Feb. 1967–Jan. 1968
Bart J. Nigro, Richard A. Woodward, and Russell C. Brucks May 1968 314 p refs
(Contract AF 33(615)-3523)
(AMRL-TR-68-4; AD-673372)

An extension of a previous comprehensive and rigorous mathematical analysis of numerical integration techniques for real-time digital flight simulation as reported in AMRL-TR-67-4 is

presented. This study has resulted in the creation of a FORTRAN computer program (The Simulation Analyzer Program) which can derive an optimum numerical integration method to solve the differential system associated with a simulation problem and satisfy all requirements (accuracy, speed, etc.) specified by the user. The Simulation Analyzer Program may also be used to evaluate user-supplied numerical integration methods for a given simulation problem. In the derivation of optimum methods as well as in the evaluation of user-supplied methods, the program considers consistency requirements, stability, truncation error, round-off-error, propagated error, and required computing time. This report includes a description of a family of three-step numerical integration methods which have arbitrarily large stability intervals and arbitrarily small truncation errors. Also included is a derivation of an exact expression for the propagated error produced in the numerical solution of a differential equation and a closed-form expression for percentage of error in the numerical solution. These derivations represent important advances in the state-of-the-art of numerical analysis. Author (TAB)

N68-36818# Sandia Corp., Albuquerque, N. Mex. Operating Systems Div.
SINK
S. W. Sherman Oct. 1967 18 p
(Contract AT(29-1)-789)
(SC-TM-67-795) CFSTI: HC $3.00/MF $0.65

SINK is a CDC 3600 program written in FORTRAN and COMPASS which translates 3600 FORTRAN (Version 5.2) to Univac FORTRAN V. Author (NSA)

N68-36835# Battelle-Northwest, Richland, Wash. Pacific-Northwest Lab.
COMPUTER RETRIEVAL OF CSE MULTIPLEXER DATA
W. R. Weissenberger and E. L. Wells Sep. 1967 39 p refs
(Contract AT(45-1)-1830)
(BNWL-693) CFSTI: HC $3.00/MF $0.65

Descriptions of PDP-7 computer programs to allow the retrieval of multiplexer data from the Containment System Experiment are given. Program listings and flow-diagrams of the programs are included. Author (NSA)

N68-36898# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATIONAL EXPERIENCE WITH THE 'URAL' DIGITAL COMPUTER (CHAPTERS 1 AND 3)
M. V. Burakov 18 Sep. 1967 34 p Transl. into ENGLISH from the book "Opyt Eksplustatsii Tsifrovoy Vychislitel'noy Mashiny Ural" Moscow, 1962 p 5–19, 66–75
(FTD-HT-67-313; AD-673391)

Chapter 1 contains a description of the Ural computer. It is classed as a small automatic universal electronic digital computer, intended for use in computing centers, research institutes, design and construction bureaus, and in any other organization for the solution of the most varied engineering, mathematical, and logical problems. Its basic specifications are given, and its component units described. The principles of operation are given in sequence. Chapter 3 deals with the work organization, and describes the number of work shifts and their hours of duty. Maintenance was performed according to instructions on a daily, weekly, monthly quarterly, and annual basis. Each of these maintenance schedules is described together with the necessary records required. TAB

N68-36905# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME MATHEMATICAL PROBLEMS ARISING IN JOINT OPERATION OF SEVERAL COMPUTERS [O NEKOTORYKH MATEMATICHEKIKH PROBLEMAKH, VOZNIKAYUSHCHIKH PRI SOBMESTNOI RABOTE NESKOLKIKH VYSCHISLITELNYKH MASHIN]
D. A. Pospelov 18 Aug. 1967 20 p refs Transl. into ENGLISH from Tr. Mosk. Energ. Inst. Vychislitel'naya Tekhn. (Moscow), no. 53, 1963 p 97–110
(FTD-HT-67-33; AD-673411)

Certain problems of a theoretical nature, arising in the development of a computational system consisting of several computers, are examined. The functions of the central machine exercising the control over the other machines and distributing work among them (the director-machine), are listed. A method of presenting computer programs in the form of an oriented graph is described and a method of ordering the vertices of that graph with respect to tiers is pointed out. The concept of width and length of the tier is introduced, and the means of these quantities are determined. Along with the graph-diagram of a program, a functional block diagram of the algorithm being realized is presented. Together, these two diagrams give an idea of the structure of the program and the possibilities for its optimal realization in the computational system. The author expresses the idea of converting the algorithm from a sequential to a series-parallel form in accordance with the proposed realization of this algorithm in a system of a parallel-operating digital computers. As an example, the distribution of program operators among the computers in a system of this kind is examined. TAB

N68-36940# National Physical Lab., Teddington (England). Computer Science Div.
THE COMPUTER CONTROL OF A DISTILLATION COLUMN
B. J. Williams (Imperial Coll. of Sci. and Technol.) Jul. 1968 132 p refs
(NPL-COM-SCI-37) CFSTI: HC $3.00/MF $0.65

A steady-state model of a binary distillation column is derived from material balance considerations and a digital computer program is described which calculates the vapor and liquid flow-rates at each plate in the column. Theoretical and experimental results are shown to agree closely, and a dynamic model of the column is derived which, when programmed on a digital computer enables the transient behavior for large disturbances to be calculated. Agreement with plant data is presented both for step and P.R.B.S. disturbances in the column operating variables. It is further shown how to simplify the complex system of describing equations to a 2nd-order discrete time form, a simplification which is validated by plant measurements. The use of these models in designing closed-loop controllers is discussed and their implementation by a digital computer used to regulate the top-product composition by controlling the reflux ratio is described. The same control algorithms are also used to change the set-point of the top-product composition. Author (ESRO)

N68-36942 Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
HYBRID OPTIMIZATION PROGRAM 8 (RISO 8-10-H)
P. LaCour Christensen Mar. 1968 20 p
(R-14-68; RISO-M-727) CFSTI: $3.00

The program can optimize a 1–8 parameter system set up on the analog computer on the basis of an analog calculated performance criterion. The optimization method is the steepest descent method. Author

N68-36943 Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
MULTIPLE FAST FUNCTION GENERATOR (RISO 8-11-H) PROGRAMS FOR EAI 680 AND PDP 8
K. Soe Hojberg Mar. 1968 14 p
(R-13-68; RISO-M-726) CFSTI: $3.00

The multiple fast function generator program is used for the introduction of several arbitrary functions in hybrid computation. The y address in the PDP 8 memory is derived in a direct way from the read in x value, and the y value is read out without time consuming scaling, interpolation etc. The multiple interpolating loader program is used in connection with the set up of function tables in the PDP 8 core memory. These tables can be used in the multiple fast function generator described. Several functions given as discrete points are converted to practically continuous curves by means of cubic interpolation. Author

N68-36955# Atomic Energy Commission Research Establishment, Riso (Denmark).
ORGANIZATION AND USE OF MAIN LISTS IN MEMORY PDP 8/DR 2 SYSTEM
L. P. Goodstein Oct. 1967 14 p
(RISO-M-641; R-20-67)

This report has been prepared for users of the PDP 8/DR 2 system which is currently under development. It describes the organization of and access to parameters stored in memory which are related to the data collected from the process. Author (NSA)

N68-37014# European Space Technology Center, Noordwijk (Netherlands).
THE COMPUTATION OF SHAPE FACTORS FOR SPACECRAFT APPLICATIONS
M. Toussaint Paris ESRO Feb. 1968 44 p refs
(ESRO-TM-114(ESTEC)) CFSTI: HC $3.00/MF $0.65

The purpose of this paper is to provide the engineer with a mathematical tool enabling him to calculate the complete matrix of shape factors for a given set of grey surfaces obeying Lambert's cosine law and constituting a thermal enclosure. The method of calculation is described, which adopted in a digital computer program used at ESTEC, the listing of the program and a short specification are presented. ESRO

N68-37060# Rocket Propulsion Establishment, Westcott (England).
A DEVICE FOR READING 'WEEDRAM' MAGNETIC TAPES INTO AN ELLIOTT 503 COMPUTER AND FOR CONTROLLING A DIGITAL INCREMENTAL PLOTTER
P. J. Worrell Nov. 1967 42 p refs
(RPE-TR-67/15) CFSTI: HC $3.00/MF $0.65

A device has been developed for reading magnetic tapes recorded by WEEDRAM digitizers and transferring the recorded data into the interface matching unit of an Elliott 503 computer for analysis. The device also controls the operation of a digital incremental plotter, either indirectly by first recording the plotter instructions at high speed or directly from the computer. Author (ESRO)

N68-37109# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNIVERSAL DIGITAL CONTROL [UNIVERSALNAYA TSIFROVAYA UPRAVLYAYUSHCHAYA MASHINA]
B. M. Kagan, V. M. Dolkart, and G. Kh. Novik 22 Aug. 1967 33 p Transl. into ENGLISH from Russian Patent No. 170218 (Appl. no. 885812/26-24, 6 Mar. 1964)
(FTD-HT-67-21; AD-673410)

The proposed machine differs from existing machines in that the trigger adder is connected place-by-place with the mutually-complementing outputs of the readout amplifiers, which are connected with the information readout windings of the ferrite memory unit, whose excitation circuits are connected through an OR circuit with the trigger-controlled 12-place address register and with the supplementary four-place trigger register of the fixed address. The proposed machine also differs in that two groups of AND circuits are connected to the inputs of the trigger and the 1s carry pulse shaper, and to one group of the AND circuits there are connected the corresponding outputs of the trigger, the outputs of the read amplifier, and the source of the add instruction, while to the other group of AND circuits there are connected the corresponding trigger outputs, the read amplifier outputs, and the subtract instruction source. This provides increased reliability of the adder operation. Author (TAB)

N68-37254*# Wolf Research and Development Corp., West Concord, Mass.
DATA DISPLAY PROGRAMMING
Washington NASA Sep. 1968 304 p refs
(Contract NAS5-9756-47)
(NASA-CR-1107) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Consideration is given to the problem of developing more efficient means by which the physical scientist might intimately control the complex data processing operations involved in the analysis and meaningful interpretation of large volumes of sensor data from scientific satellites. Areas of computer graphics technology in which pioneering efforts might prove fruitful are defined and approaches conceived. The results of pilot tests to evaluate proposed techniques from a human factors viewpoint are given. Specific techniques include information transfer via uncommon display media (full color; flicker; animation) and approaches to facilitate the use of a single input device as the means of processing control. Specifications are developed for an advanced hardware-software system for manipulating and displaying large volumes of data. A man computer communication station design is recommended which permits finger pointing as a means of input and peripheral equipment to service the display and input devices. Computer software to support man-computer communication is specified using a hierarchical approach. Author

N68-37282# State Inst. for Technical Research, Helsinki (Finland).
TAPE PREPARATION PROGRAMS FOR MATHATRON DIGITAL COMPUTER SYSTEMS. PART 2: H + AND PH VALUES OF ELECTROLYTE SOLUTIONS
Asko Vaspas 1968 108 p refs
(Publ.-128) CFSTI: HC $3.00/MF $0.65

Thirty detailed tape preparation programs are compiled, intended for calculations concerned with the hydrogen ion concentration and pH values of electrolyte solutions. The programs for the Mathatron digital computer systems were constructed with speed and ease of operation in mind. The symbols and formulae used are listed. A statement of the problem is presented, followed by a detailed description of the problem. The complete program is given, with all the instructions necessary for the preparation of a tape, along with the machine printout of the tape created in TYP-mode. Examples are presented in the form of actual machine printouts. Author

N68-37357*# California Univ., Los Angeles. Dept. of Engineering.
INVESTIGATION OF THE FIELD OF PROBLEMS FOR THE BOOLEAN ANALYZER
Miguel A. Marin Jun. 1968 183 p refs
(Grant NGR-05-007-201; Contracts Nonr-233(52); ARPA SD-184; AT(11-1)-Gen-10)
(NASA-CR-97264; Rept.-68-28; AD-672558) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Recently, a new processor, called Boolean analyzer (BA), has been proposed by A. Svoboda. This unit operating as a part of an automatic computer is based on the idea of processing many terms of Boolean algebra in parallel. One of its operational capabilities is the solution of large systems of Boolean equations in a reasonable time (if we compare it to standard procedures). In order to promote the use of the Boolean analyzer in its two modes of operation we developed some applications to logic problems. In this report we propose to show how the Boolean analyzer should be integrated with a general purpose computer (or with a variable structure computer) to solve efficiently: (1) the three-level and and-not synthesis problem of logic networks using only true inputs (synthesis of TANT networks), and (2) the general problem of synthesis of logic networks using a restricted inventory of integrated circuit modules, our task includes reformulation of those problems into Boolean equations to prove their solubility by a Boolean analyzer integrated with another system. Author (TAB)

N68-37373 Bolkow Entwicklungen K. G., Munich (West Germany).
THE STORAGE OF MEASURED RADIATION DIAGRAMS ON MAGNETIC TAPE AND THEIR EVALUATION [DIE SPEICHERUNG VON GEMESSENEN STRAHLUNGS DIAGRAMMEN AUF MAGNETBAND UND DEREN AUSWERTUNG]
M. Pfisterer 8 Sep. 1967 15 p In GERMAN Presented at the NTG Conf. on Antennas and Electromagnetic Fields, Darmstadt, West Ger., 17–20 Oct. 1967
(EP-93-O) CFSTI: $3.00

A system for the simultaneous measurement and recording of antenna radiation patterns and diagrams is described. The system consists of a digital magnetic tape recorder, the required control electronic, and a diagram integrator for the analog to digital conversion. This intermediate storage allows a fast computer evaluation of the stored information. Examples are given of additional computer processing possibilities of the stored data, including: (1) integration of spatial radiation diagrams; (2) plane representation of spatial radiation patterns; (3) distribution of antenna gain; (4) calculation of diagrams of antenna arrays and (5) representation of polarization conditions. Transl. by K.W.

N68-37385*# Yale Univ., New Haven, Conn. Dept. of Statistics.
USE OF IVERSON'S LANGUAGE APL FOR STATISTICAL COMPUTING
Francis J. Anscombe Jul. 1968 46 p refs Submitted for publication Sponsored in part by NASA
(Contract Nonr-609(52))
(NASA-CR-97263; TR-4; AD-672557) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Problems of communication between statistician and computer are reviewed, needs are diverse, for the professional mathematically-oriented statistician Iverson's language APL is very suitable, more so than special statistical computing systems. A partial description of APL is given, and illustrated by some typical statistical calculations. An experimental implementation of the language in conversational mode through typewriter terminals is described. The system may be used as a desk calculator, and programs and data may be stored. The purpose of the paper is not to duplicate the manual, but to convey the flavor and suggest the suitability of APL for expressing statistical calculations, without presenting too much unfamiliar notation. Two attractive features of the language are its capacity to represent array operations concisely and its high degree of consistency and generality. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-36091 Washington Univ., St. Louis, Mo.
THEORY AND APPLICATIONS OF COAXIAL FERRITE DEVICES
Ralph Stephen Mueller (Ph.D. Thesis) 1967 217 p
Available from Univ. Microfilms: HC $9.90/Microfilms $3.00 Order No. 67-17171

Propagation of electromagnetic waves in a ferrite filled coaxial waveguide and along a wire loaded with a ferrite tube has been studied for the cases of longitudinal and azimuthal magnetization. The boundary value problems have been solved for these configurations and the modal spectra displayed as normalized dispersion (ω-β_Z) diagrams. The dependence of phase shift as a function of applied field is also shown for these waveguides. X band microwave resonators in the same geometries were constructed and the experimental resonant frequencies obtained are compared with the results predicted in the above analysis. The operation of a Y-junction circulator is explained in terms of the modes on a wire loaded with a ferrite tube. An experimental circulator was designed whose response validated this analysis. Dissert. Abstr.

N68-36197# Martin Co., Denver, Colo.
TECHNOLOGY FEASIBILITY SPACECRAFT (TFS) TECHNOLOGY REPORT. VOLUME 1: ELECTRONIC PACKAGING Final Report
L. Parham Oct. 1967 323 p refs
(R-68-2, V. 1; AD-673563)

An electronic packaging program was initiated to develop and evaluate integrated circuit packaging techniques applicable to unmanned scientific spacecraft data systems. This was accomplished by a design, develop and demonstrate approach through engineering, manufacturing, and testing for a space environment. Author (TAB)

N68-36326 Stanford Univ., Calif.
A THEORY OF SATURATION AND A CHARGE CONTROL ANALYSIS OF A JUNCTION FIELD EFFECT TRANSISTOR
Philip Leland Hower (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17441

This study is concerned with two topics: (1) a theory of saturation of the junction field-effect transistor (FET) that is based upon an approximate solution of Poisson's equation in the drain region, and (2) a charge-control analysis of the drain characteristic of a junction FET. An approximate solution for the electrostatic potential in the drain region of a junction FET is presented which successfully explains the low-frequency behavior of a device operating in the saturated range. Formulas are derived for drain-to-source resistance r_{ds} and transconductance g_m which are explicit functions of device dimensions and impurity density. Measured and calculated values of r_{ds} and g_m show excellent agreement throughout the saturated portion of the drain characteristic. Simple estimates indicate that the drain current is a linear function of gate charge for a junction FET operating in the saturated range. This approximation is verified by an exact calculation of the drain characteristic with gate charge as the parameter. Dissert. Abstr.

N68-36330 Michigan Univ., Ann Arbor.
THE SODIUM SALICYLATE-COATED PHOTOMULTIPLIER AS A DETECTOR IN THE EXTREME ULTRAVIOLET
Duane Arthur Warner (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-15719

The objective of this research is to determine the effectiveness of a sodium salicylate-coated photomultiplier as a detector of radiation in the extreme ultraviolet region from 100 Å to 370 Å by comparing its response with that of the Kodak SWR photographic emulsion, as determined by R. W. Kebler, and with the response of a Bendix windowless photomultiplier as determined by G. T. Oser. The sodium salicylate-coated 1P21 photomultiplier is found to be a very satisfactory EUV detector. It is at least as sensitive as the Bendix multiplier and appears to have a similar spectral response. Both are much more sensitive than the SWR emulsion and show less decrease in spectral response at shorter wavelengths; however, the fact that sodium salicylate is sensitive to radiation of all wavelengths whereas the Bendix multiplier does not respond at all above about 1400 Å may make a considerable difference in certain applications. Dissert. Abstr.

N68-36353# Library of Congress, Washington, D. C. Aerospace Technology Div.
OPEN MILLIMETER-BAND RESONATORS
Stuart G. Hibben *In its* Foreign Sci. Bull. Sep. 1968 p 1-30 refs (See N68-36352 23-23)

Several types of open microwave resonators, designed on quasi-optical principles, have operated successfully as generators in the millimeter band. The test models exhibit high Q and low spectral densities. The techniques developed show promise for extending open resonator design into the submillimeter range. Author

N68-36447# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RLC REALIZATIONS OF APPROXIMATIONS TO MATCHED FILTERS FOR A RECTANGULAR PULSE
John W. Craig 30 Jul. 1968 35 p refs
(Contract AF 19(628)-5167)
(TN-1968-21; ESD-TR-68-231; AD-673883)

Several low order rational transfer functions have been found which approximate a matched filter for a rectangular pulse. These transfer functions are optimum in the sense that the ratio of peak-signal to rms-noise at the output is maximized to the extent allowed by the available parameters. Normalized transfer functions are given and their frequency and time response are shown graphically. For the most useful cases, realizations normalized in impedance and pulse duration are given which allow the use of lossy inductors. A short discussion of a bandpass realization is presented. A transfer function with zeros restricted to the omega-axis is given, along with its realization, which is useful as the lowpass prototype of a bandpass, crystal matched filter. Author (TAB)

N68-36583*# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
THERMIONIC CATHODE EVALUATION STUDY Interim Report, 1 Apr.-30 Jun. 1968
F. T. Hill 5 Aug. 1968 17 p Prepared for JPL
(Contracts NAS7-100; JPL-951810)
(NASA-CR-97194; PT-1951; IR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09A

During the fifth interim period of thermionic cathode evaluation, diodes using pore-dispenser cathodes have completed at least 6700 hours of life burning and are operating satisfactorily at cathode temperatures of 950°C to 1100°C and at current densities of 0.2 A/cm^2 to 1.6 A/cm^2. Diodes using standard barium-strontium-oxide cathodes have completed life burning times varying from 3400 to 5500 hours. The diodes are showing cathode emission slump at current densities above 0.15 A/cm^2 and cathode temperatures of 825°C and 850°C under T_3 and T_4 operating conditions. A new cathode evaluation program using three new nickel cathode alloys with oxide cathodes and coated particle cathodes in the test diode is outlined. Author

N68-36587*# Watkins-Johnson Co., Palo Alto, Calif.
A 50 PERCENT EFFICIENT, 100 WATT S-BAND TRAVELING-WAVE TUBE Final Report
L. A. Roberts 15 Jul. 1968 51 p refs
(Contracts NAS7-100; JPL-951299)
(NASA-CR-97222; WJ-395) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This is the final report on a program to develop a 100 watt, 55 percent efficient traveling-wave tube at 2.295 GHz for space communication and telemetry applications. The report describes the design basis and the operating characteristics of the final version of the tube, which is known as the WJ-395. The best overall efficiency performance including heater) achieved was 50.5 percent at a power output level of 105 watts and a saturation gain of 38 dB. The final encapsulated version of the tube exhibits an overall efficiency greater than 49 percent. The tube is capable of meeting the shock, vibration and acceleration associated with spacecraft launching and is capable of operating under space vacuum conditions using only conduction cooling. The report also describes the state of the art in high efficiency traveling wave tubes at the inception of the program and describes developments which took place during the course of the program which had direct bearing upon its efficiency design. Author

N68-36621*# Research Triangle Inst., Durham, N. C. Engineering and Environmental Sciences Div.
ACCELERATED TESTING OF ELECTRONIC PARTS Final Report
Ralph A. Evans Apr. 1968 114 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951727)
(NASA-CR-97207) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This report discusses the four kinds of uses to which accelerated testing is put; three of them are qualitative, and the fourth is quantitative prediction. The different ways of programming the severity levels in an accelerated test are listed. The main ones are constant-'stress' test step-'stress' tests. In order to compare these it is necessary to have some theory of cumulative damage. Thermal acceleration is by far the most usual and easy way of accelerating a test. There is not magic, ideal formula to which properly made things must conform but there are useful equations, the Arrhenius being the most ubiquitous. After having run an accelerated test most everyone wishes to extrapolate to the usual conditions and the dangers inherent in this process are explained and evaluated. This is followed by brief discussions on how the accelerated testing has been handled in the literature for resistors, capacitors (dielectrics), discrete semiconductors, and integrated circuits. Discussions of mathematical details and specialized techniques are included in the appendixes. Author

N68-36668*# Information Dynamics Corp., Reading, Mass.
AN INDEPENDENT MANAGEMENT CRITIQUE OF THE NASA MICROELECTRONIC RELIABILITY PROGRAM
Feb. 1967 85 p
(Contract NAS12-147)
(NASA-CR-97217; R-8090-2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The probable effectiveness of the microelectronic reliability program was evaluated, and an estimate was made of its acceptibility to potential participants. Field interviews were conducted

to survey the potential user community's requirements for data bank services, and to gather in-depth attitudes toward the program among microelectronic manufacturers, NASA Centers, and contractors. It was concluded: (1) Preparation of specifications, standards, survey and procurement procedures, and the operation of the data bank as a communication system reaching all NASA participants will reduce unnecessary duplicate expense. (2) Program success probability can be increased if NASA combines forces with other government agencies and presents common procedural requirements to industry. (3) Acceptance by manufacturers, although ultimately favorable, will require careful presentation and implementation by highly trained personnel. (4) The most significant technical problems are identified as developing effective line certification procedures acceptable to industry, and developing a sufficient depth of technical understanding to allow for the introduction of abridged qualification tests on new devices that are members of a qualified family. M.G.J.

N68-36761# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).

A TWELVE CHANNEL OSCILLOSCOPE [OSCILLOSCOPE A 12 VOIES VERTICALES]

J.-P. Perotti Dec. 1967 31 p refs In FRENCH
(LRP-34/67)

A 12-beam oscilloscope is described. The Y amplifiers, the response of which extends from 10 c/s to 25 Mc/s and the sensitivity from 50 mV to 5 V/cm, are transistorized. The power consumption, 1 kW, is reasonably low. The sweep rates range from 0.1 to 500 μsec/cm. Author (NSA)

N68-36842# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.

DESIGN OF A TRANSISTORISED UNIT FOR AUTOMATIC CHANNEL STEPPING OF 512-CHANNEL LABEN ANALYSER

Ahmed Ali Aug. 1967 7 p
(PINSTECH/PHY-11)

The design of a transistorized unit for automatic channel stepping of the 512 channel Laben Analyzer operating in the multiscaler mode is described. The unit is very useful for determining short half lives. It can accept count rates up to 100 kc/sec. Author (NSA)

N68-36965# Japan Broadcasting Corp., Tokyo. Technical Research Lab.

CAPACITIVE COUPLING TYPE COAXIAL SWITCH

Yoshihiro Konishi, Shiro Ito, and Norio Hoshino Jul. 1968 19 p *Its* Lab. Note Seriel No. 121
CFSTI: HC $3.00/MF $0.65

Electrical characteristics are detailed for a capacitive coupling type coaxial switch that was developed for broadband operation and can be applied to very high frequency FM and TV. Temperature rise in the switch did not present a problem during actual use; and the mechanism of heat discharge as well as the means for its calculation are presented for the switch, which has coupling conductors that are isolated. M.W.R.

N68-37106# Weapons Research Establishment, Salisbury (Australia).

SPACE CHARGE OSCILLATIONS IN THE CYLINDRICAL MAGNETRON

E. H. Hirsch Dec. 1967 20 p refs
(WRE-TN-CPD-140) CFSTI: HC $3.00/MF $0.65

It is found that in a smooth anode cylindrical magnetron oscillations due to slipping stream interactions have frequencies which are linearly proportional to the magnetic field strength and are independent of the anode voltage. An earlier theory predicting a different field and voltage dependence is shown to be incorrect. For thin cathodes and low emission current the frequencies are integral multiples of the cyclotron frequency. This is confirmed by experiments, which also indicate that the oscillations cause the flow of anomalous anode current. Author (ESRO)

N68-37263 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).

ON A NEW TYPE OF X-RAY GENERATOR

W. J. H. Beekman (Ph.D. Thesis—Tech. Hogeschool Eindhoven, Nov. 1967) 1968 50 p refs *Its* Res. Rept. Suppl. No. 7

The principle of the described X-ray generator is a variation upon the direct-current inductor, the grid-controlled X-ray tube itself acting as the interrupter. The anode of the X-ray tube is connected to a constant-voltage generator via a high-inductance coil. The capacitance is constituted by the sum of the capacitances of the tube, the leads and the coil. The main feature of the X-ray tube is the electron gun, consisting of a multi-grid construction of the Pierce type and a dispenser cathode with a concave emitting surface. The tube current is controlled by variation of the accelerating-grid voltage. By applying periodically a negative voltage pulse of rectangular wave form to the accelerating grid the capacitance is loaded at a low voltage and discharged at a high voltage alternately. The main data are: maximum voltage 250 kV, maximum tube current 300 mA, repetition frequency about 1100 c/s, discharge time about 50 μs. Also a spectrometer is described specially designed for measuring the high voltage and the spectral-energy distribution of the X-radiation produced. Author

N68-37299# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEMICONDUCTOR TECHNOLOGY AND MICROELECTRONICS

25 Aug. 1968 220 p refs Transl. into ENGLISH of the book "Poluprovodnikovaya Tekhnika i Mikroelektronika" Kiev, Naukova Dumka, 1966 p 1–170
(FTD-MT-24-135-67; AD-673189)

The article discusses the trend towards microelectronics, particularly optoelectronic devices, such as photoelectrical function converters whereby a light ray is used as a control signal, coupling element, or converting link. Most promising type appears to be of the electroluminescent category, with advantages in long life and microminiature dimensions. The fundamental arrangement of an electroluminescent cell is outlined. Powder phosphors are compared for suitability. It concludes with a detailed discussion of elementary optrons, their characteristics and areas of application. Author (TAB)

N68-37302# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PHOTOPOTENTIOMETER AS A FUNCTIONAL CONVERTER [FOTOPOTENTSIOMETR V REZHIME FUNKTSIONAL'NOGO PREOBRAZOVATELYA]

A. N. Zyuganov *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 43–49 refs (See N68-37299 23-09)

The possible uses of a photopotentiometer of transverse conductivity as a function converter with practically arbitrary function of conversion are discussed. A theoretical calculation is given for the profile of resistance layer for realization of functional conversion in potential and current cases leakage currents not considered. The current operating conditions of a device of transverse conductivity during realization of functional conversion are examined. Potential operating conditions turns out to be a particular case of high load impedances. Author

N68-37303# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL AND OPTICAL CHARACTERISTICS OF ELECTROLUMINESCENT INDICATORS [ELEKTRICHESKIYE I OPTICHESKIYE KHARAKTERISTIKI ELEKTROLYUMINESTSENTNYKH INDIKATOROV]
F. I. Kolomoytsev, F. F. Kodzhespirov, V. M. Pilipenko, and A. Ya. Yakunin *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 50–59 refs (See N68-37299 23-09)

The electrical and optimal characteristics of electroluminescent indicator are examined. The method of testing capacitive and resistive load, changes in voltage, frequency, resistance, and power drain is described. The optical characteristics required study of glow during changing parameters of voltage and frequency. The substance was chosen because it is brightest and the color green is closest to the sensitivity of the human eye. The article describes the spectral characteristics, brightness of glow, loss of brightness and subsequent recovery of the tested substance. A determination of recommended voltage and frequency for this particular indicator is included. Author

N68-37304# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR PROPERTIES OF ELECTROLUMINESCENT INDICATORS [NELINEYNYYE SVOYSTVA ELEKTROLYUMINESTSENTNYKH INDIKATOROV]
V. M. Pilipenko *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 60–66 refs (See N68-37299 23-09)

In the process of investigating the electrical conductivity of excited electroluminescent cells it was noted that with exciting voltages of audiofrequency on the order of 50-150 V, a d-c component of current appears. The value of voltage for which this component is revealed depends on the concentration of phosphor. Thickness of the electroluminescent layer, and presence in the cell of additional reflecting (protective) layer containing TiO_2. Numerous sample cells were tested having different ratios of resin and electroluminophor. In all cases the polarity of d-c component of voltage across the samples was identical. The analysis performed is described in detail. Author

N68-37305# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FOUR-ELEMENT POSITION-SENSITIVE PHOTODIODES [CHETYREKHELEMENTNYYE POZITSIONNO-CHUVSTVITELNYYE FOTODIODY]
L. S. Ayvazova, T. Ya. Gorbach, K. M. Krolevets, and V. N. Savelo *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 67–77 refs (See N68-37299 23-09)

Photoelectric cells for conversion of optical position or displacement sensors must have position sensitivity, must be able to determine direction to light source and to record its position and movement. The article gives results obtained during the study of four-element germanium and silicon photodiodes are given. The investigations permitted conclusion that four-element position-sensitive photodiodes of germanium and silicon in totality of properties are promising for use as sensors for photoelectical servosystems. Author

N68-37306# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COORDINATE PHOTODIODE MATRIX [KOORDINATNAYA FOTODIODNAYA MATRITSA]
F. N. Maslovskiy *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 78–84 (See N68-37299 23-09)

Results of a study to determine the design and method of manufacture of a photodiode matrix in the form of a solid circuit of monolithic germanium are presented. A method of suitable circuitry is presented, describing the manufacture of buses, using molybdenum as the best material. Formation of the plate and formation of the matrix is described in detail, i.e. fusion of buses to plate, and removal of shorts between vertical buses through the plate. Statistical photoelectric parameters of a test sample matrix are included. Author

N68-37310# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYSTEM OF PULSE PARAMETERS OF SEMICONDUCTOR DIODES [O SISTEME IMPUL'SNYKH PARAMETROV POLUPROVODNIKOVYKH]
Yu. A. Tkhorik *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 104–109 refs (See N68-37299 23-09)

Knowledge of pulse parameters is necessary for selection of diodes for specific circuits. Pulse parameters include: maximum forward pulse resistance, time constant of forward resistance, and recovery time of reverse resistance. Practical method of determining these components are presented. Author

N68-37314# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GERMANIUM PULSE TRANSISTOR [IMPUL'SNYY GERMANIEVYY TRIOD]
F. N. Maslovskiy *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 132–140 (See N68-37299 23-09)

Experimental results obtained during development of a high-power, high-speed, pulse-type germanium p-n-p drift transistor are described. The p-n-p structure of the device is created by fusion-diffusion of a batch of alloy containing acceptor and donor impurities in a plate of p-type germanium, while contact with base is made through base connecting n-layer, obtained by diffusion of donor impurity from gas phase. A description of the transistor developed as a result of the experiment is given together with details of its characteristics. Author

N68-37315# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILIZATION OF INPUT IMPEDANCE OF CHANNEL TRANSISTORS BY EXTRACTION OF MINORITY CHARGE CARRIERS [STABILIZATSIYA VKHODNOGO SOPROTIVLENIYA KANAL'NYKH TRANZISTOROV PUTEM EKSTRAKTSII NEOSNOVNYKH NOSITELIY ZARDYADA]
L. A. Zubritskiy *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 141–148 refs (See N68-37299 23-09)

Experiments with different types of channel transistors are reported whereby extraction of minority charge carriers was achieved by introduction of an auxiliary gate. Details of construction of such a gate are provided. Author

N68-37316# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INDUCTIVE PROPERTIES OF PLANAR (JUNCTION) TRANSISTORS [INDUKTIVNYYE SVOYSTVA PLOSKOSTNYKH TRANZISTOROV]
V. S. Osadchuk *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 149–152 refs (See N68-37299 23-09)

A report of investigation of the inductive properties of transistors is given along with details of the method of measurement and equations involved. Author

N68-37317# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF REAL AND IMAGINARY PARTS OF IMPEDANCE OF SEMICONDUCTOR DEVICES AT HIGH

FREQUENCIES [IZMERENIYE DEYSTVITEL'NOY I MNIMOY CHASTEY POLNOGO SOPROTIVLENIYA POLUPROVODNIKOVYKH PRIBOROV NA VYSOKIKH CHASTOTAKH]
M. M. Nekrasov and V. S. Osadchuk *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 153–155 refs (See N68-37299 23-09)

A vector diagram and formulas are given for calculation of real and imaginary parts of impedance. Author

N68-37318# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-TEMPERATURE THERMISTOR BASED ON SYSTEM ZnO-NiO-Fe_2O_3 [BYSOKOTEMPERATURNYY TERMISTOR NA OSNOVE SISTEMY ZnO-NiO-Fe_2O_3]
Ye. N. Dimarov *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 156–159 refs (See N68-37299 23-09)

An experimental application of system ZnO-NiO-Fe_2O_3 as a high temperature thermistor is described. High stability of electrical parameters in a wide range of temperatures, large valve of temperature coefficent of resistance, and high values of maximum disspated power and maximum voltage indicate that the material tested is suitable as a thermistor for a wide range of temperatures. Basic parameters are included. Author

N68-37378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSISTORIZED LOGARITHMIC AMPLIFIERS
V. M. Volkov 11 Oct. 1967 198 p refs Transl. into ENGLISH of the Monograph Logarifmicheskie Usiliteli na Tranzistorakh (Kiev), 1965 p 1–266
(FTD-MT-24-118-67; AD-673413)

The book deals with the theory of transistorized aperiodic and selective amplifiers with logarithmic amplitude characteristics. The general methods of obtaining logarithmic amplitude characteristics, practical solutions of this problem, and tuning and adjusting of logarithmic amplifiers are discussed. Practical circuits are shown. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-36047 Cornell Univ., Ithaca, N. Y.
AN ALGEBRAIC TIME DOMAIN APPROACH TO LINEAR TIME-VARIABLE NETWORKS
Richard Seeks (Ph.D. Thesis) 1967 227 p
Available from Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 68-676

Formal differential operator techniques are employed to extend a number of results from classical network theory to the case of linear time-variable networks. The results fall into two classes—those which employ the specific properties of the differential operators, and those more general, function analytic, results which assume only operator linearity. The former yield algorithms for the synthesis of the lossless and active time-variable n-ports and analysis procedures for time-variable RC and RL networks. The latter yield synthesis procedures for passive time-variable n-ports and the analysis of general linear networks. The procedure formulated are intended both as solutions to the specific problems of linear time-variable networks and as a "stepping stone" between classical network theory and the theory of generalized networks. Dissert. Abstr.

N68-36084 California Univ., Berkeley.
MODEL REFERENCE ADAPTIVE CONTROL THEORY WITH APPLICATIONS TO MANUAL CONTROL SYSTEMS
Charles Rashed Wasaff (Ph.D. Thesis) 1967 267 p
Available from Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 68-179

The investigation of an adaptive controller which operates on normally available system state variables and which compensates for deviations in human operator response from a desirable mode of response is presented. In order to illustrate the theory, several examples where human operators are engaged in compensatory tasks are considered. A particular method for the characterization and identification of an unknown process is studied, both in the absence and presence of noise. The results of this study are applied in the area of modeling human response characteristics when the operator is engaged in a compensatory task. Several examples are presented. A particular theory of model reference adaptive control systems is examined. A performance index is defined and is minimized by adjustment of the controller coefficients using steepest descent techniques. Convergence of the controller coefficients to their desired values is proved when the plant is stationary, and the order of the controller is matched to that of a defined auxiliary system. Dissert. Abstr.

N68-36087 Stanford Univ., Calif.
DESIGN OF LOW-ORDER FEEDBACK CONTROLLERS FOR LINEAR MULTIVARIABLE SYSTEMS
Paul Hunter Haley (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17431

A very low order controller design procedure, developed through the combined use of the more recent state variable formulation of control problems and the older frequency-domain, transfer function description, is discussed. The results apply to the problem of controlling a constant, linear, dynamic system of order n with m inputs and m measurable outputs. The controller obtained by the application of the procedure to this problem will be, in many cases, of much lower order than n, the order of the differential equations describing the system. The method makes use of results obtained from a frequency-domain analysis of a certain class of optimal control laws and from an analysis of the frequency-domain formulation of observers. Then, as a result of the particular choice of control law and related observer design, certain dynamics are eliminated from the observer (because of their relative unimportance) to achieve a very low order controller. Dissert. Abstr.

N68-36118 California Univ., Berkeley.
FREQUENCY MULTIPLICATION AND DIVISION IN INTEGRATED CIRCUITS
William Gates Howard, Jr. (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-64

A study of oscillator configurations containing two charge-control devices results in the systematic generation of negative impedance converters and inverters, as well as positive impedance converters and inverters, as well as positive impedance converters (electronic transformers) and positive impedance inverters (gyrators). Proper imbedding of the basic two-port circuits results in the generation of the two basic feedback types. The positive feedback method requires fewer critical time constants and lower loop gain than does the negative feedback method. A voltage-controlled oscillator using voltage-variable resistances in a positive feedback configuration has been realized in hybrid-integrated form. The configuration employs automatic gain control to maintain a constant amplitude, low-distortion output. The frequency range of the integrated realization extends from 1 Kc/s to 18 Kc/s. Dissert. Abstr.

N68-36139*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
A STUDY OF THE EXTENDED LINEAR RANGE PHASE LOCK LOOP
John C. Lindenlaub and Donald P. Olsen Aug. 1968 173 p refs
(Grant NsG-553)
(NASA-CR-97141; TR-EE68-27) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The investigation and analysis of the effect of a linear phase detector with a range of 2 $n\pi$ radians, upon the acquisition time and FM threshold were performed. The theoretical acquisition time for the high signal to noise ratio (S/N) case is determined, presented, and compared with experimental data. The low S/N acquisition time is measured experimentally and a mathematical model based on regression analysis of this data is established. The FM threshold is determined for a set of parameter values from experimental input/output S/N measurements. Both random and sinusoidal modulation are considered as well as first and second order systems. These are compared with the threshold of a standard phase lock loop demodulator. It is concluded that two methods exist for exchanging low S/N threshold for improved high S/N threshold as well as increasing acquisition time. These are: increasing the loop bandwith; and increasing the linear phase error range. The loop bandwidth is optimized to provide an acceptable level of limitation of the three performance criteria. Author

N68-36212 California Univ., Los Angeles.
SUBOPTIMUM CONTROL METHODS APPLIED TO THE REENTRY PROBLEM
Brien Dale Ward (Ph.D. Thesis) 1967 205 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-17367

This research is concerned with the problem of control theory applied to dynamic systems. In this study methods of obtaining practical optimum feedback control laws are investigated for the reentry problem. These practical optimum feedback control laws are termed suboptimum since their implementation results in a degradation of performance over the exact optimum control law. The maximum principle of Pontryagin provides the theoretical basis for the optimality conditions and the resulting two point boundary value problem. Several methods of solutions to the two point boundary value problem are discussed with emphasis on the neighboring optimum method. Three separate methods of obtaining linear optimum control laws are developed. These involve the linearization about an optimum trajectory of the control variables, adjoint variables and minimum performance functions and their corresponding control system synthesis. Dissert. Abstr.

N68-36267*# Marquardt Corp., Van Nuys, Calif.
SOLID STATE IMAGE SENSOR RESEARCH
W. Hall, A. Asam, and R. Haas Jul. 1968 50 p
(Contract NAS12-553)
(NASA-CR-86104) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The objective of this contract was to adapt Marquardt's sensing techniques to image sensing devices for meteorological satellite and related applications and investigate its performance capabilities relative to these applications in the visible spectrum. A tradeoff design study indicated theoretically that an illumination range of 120:1 and a matrix of 3,000 × 3,000 image points could be achieved with the present materials. A unique ferroelectric material process for the thin film deposition of lead titanate zirconate was developed but further work is necessary to produce uniform areas of 1 × 1 inches. Several image plates were fabricated but due to the limitations in the ferroelectric material, a reasonable performance was not obtained from any large capacity plate. Functions of sensing, storage, and readout were demonstrated with a six element line array. Author

N68-36291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF THEORY OF INVARIANCE AND ITS APPLICATIONS [RAZVITIE TEORII INVARIANTNOSTI I EE PRIMENENIYA]
G. M. Ulanov 3 Nov. 1967 7 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 36, no. 9, 1966 p 108–109
(FTD-HT-23-893-67; AD-673684)

The Third All-Union Conference on Invariance Theory and its Applications in Automatic Control Systems organized by the USSR and Ukrainian Academies of Sciences, held in Kiev from 31 May to 4 June, was attended by some 500 scientists and engineers from the USSR, East Germany, Hungary, Poland, and Czechoslovakia. Papers were presented in the following sections: (a) general problems of invariance theory; (b) combined control systems; (c) invariance in sampled-data control systems; (d) invariance and sensitivity theory, invariant self-adjusting systems; (e) nonlinear invariant systems; (f) invariance in many-dimensional automatic control systems; (g) application of invariance theory to moving objects; and (h) industrial applications of invariant systems. The papers that were presented and the discussions showed that significant results were obtained in invariance theory. TAB

N68-36310 Stanford Univ., Calif.
ECONOMICAL ENHANCEMENT OF DIGITAL-NETWORK RELIABILITY VIA ERROR-CORRECTING CODES
Paul Hodges (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17438

The reliability of a network, as measured by the probability that it will operate correctly over a mission of known duration, can often be improved by the use of redundant circuitry. Redundancy can be introduced effectively by dividing the network into segments, encoding the signals between segments with an error-correcting code, and correcting errors at the input of each segment. Three classes of codes are studied in this context: (1) Replication codes, which require the largest number of redundant signals, but which use relatively simple error-correcting circuits. (2) Compact codes, which require the fewest redundant signals, but which use relatively complex error-correcting circuits. (3) Combination codes, which require intermediate numbers of redundant signals and which use error-correcting circuits of intermediate complexity. For each of the three classes of codes the cost of achieving a stated improvement in reliability is evaluated. Dissert. Abstr.

N68-36368 California Univ., Berkeley.
A NEW APPROACH TO THE GENERAL PROBLEM OF OPTIMAL FILTERING AND CONTROL OF STOCHASTIC SYSTEMS
1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-115

Optimal filtering and control of general, time-continuous, stochastic dynamical system are considered, including optimal filter-controller combination where the filter has a finite prescribed dimension. This is shown to be equivalent to a conditional optimal control problem (COCP), namely, to a class of problems where the control law must be a function of a conditioning random variable. For the investigation of the COCP functional analysis methods are used, in particular the Hille–Yosida semi-group theory. The COCP is then reduced to a simple deterministic optimal control problem on Banach spaces. The main results consist of necessary conditions for optimality of a filter-controller pair in the form of a minimum principle. This is followed by an existence theorem and an analysis of the sensitivity of the optimal system to errors in the initial probability assigned on the state space and to the terminal cost function. A computational algorithm for obtaining extremal filter-controller is described. A parallel derivation for discrete time

and/or spaces is given. Relation between Lipschitz conditions and the weak topology on sets of infinitesimal generators is described. Dissert. Abstr.

N68-36376# Joint Publications Research Service, Washington, D. C.
RESEARCH IN CYBERNETICS AND CONTROL THEORY
24 Sep. 1968 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. SSSR (Moscow), v. 181, no. 2, 1968 p 298–304
(JPRS-46510) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. ON A METHOD OF SYNTHESIZING AN INTERFERENCE-FREE SYSTEM WITH VARIABLE STRUCTURE K. K. Zhil'tsov, P. A. Ilyukhin, and A. V. Lan'shin p 1–4 refs (See N68-36377 23-10)
2. ON AN ALGORITHM FOR USING INFORMATION REDUNDANCY IN MULTIDIMENSIONAL REPRODUCING SYSTEMS P. F. Osmolovskiy p 5–9 ref (See N68-36378 23-10)

N68-36377# Joint Publications Research Service, Washington, D. C.
ON A METHOD OF SYNTHESIZING AN INTERFERENCE-FREE SYSTEM WITH VARIABLE STRUCTURE
K. K. Zhil'tsov, P. A. Ilyukhin, and A. V. Lan'shin *In its* Res. in Cybernetics and Control Theory 24 Sep. 1968 p 1–4 refs (See N68-36376 23-10)

Consideration is given to the possibility of constructing a system with variable structure in the presence of interference in the form of a random stationary process with a normal distribution. It is assumed that this interference acts on the logic-forming unit of the system. Slip state existence, self-oscillations with amplitude, and interference filtration are discussed; and the equation of motion in the slip state is given. This equation presupposes a reduction of interference level at the input of the nonlinear logic device by synthesizing systems of variable structure. M.W.R.

N68-36378# Joint Publications Research Service, Washington, D. C.
ON AN ALGORITHM FOR USING INFORMATION REDUNDANCY IN MULTIDIMENSIONAL REPRODUCING SYSTEMS
P. F. Osmolovskiy *In its* Res. In Cybernetics and Control Theory 24 Sep. 1968 p 5–9 ref (See N68-36376 23-10)

A multidimensional reproducing system was constructed in which the measurement results for all preceding coordinates would be used to determine the i-th coordinate. The problem was satisfied by recurrence formulas corresponding to an iterative reproduction process. A functional algorithm was synthesized so that during reproduction of any of the coordinates, information on the remaining coordinates would be used. A matrix equation, which describes this algorithm for using information redundancy, can be used to determine reproduction error. M.W.R.

N68-36410# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
SADDLE POINT THEOREMS AND THE DISCRETE MAXIMUM PRINCIPLE
George B. Kleindorfer, Paul R. Kleidorfer, and Gerald L. Thompson Jun. 1968 14 p refs *Its* Management Sci. Res. Rept. 134
(Contract Nonr-760(24))
(AD-673404)

A discrete maximum principle is derived from Kuhn-Tucker theory. Difference inequalities and state space constraints are included. An example is given illustrating the relationship of the present work to other maximum principles. Author (TAB)

N68-36439# Joint Publications Research Service, Washington, D. C.
QUALITY INDICES AND THE ITERATION PRINCIPLE IN AUTOMATIC CONTROL
25 Sep. 1968 18 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 181, no. 1, 1968 p 35–41
(JPRS-46523)

CONTENTS:
1. THE RELATION OF CERTAIN QUALITY INDICES IN CONTROLLABLE LINEAR STATIONARY SYSTEMS L. S. Gnoyenskiy p 1–8 refs (See N68-36440 23-10)
2. THE ITERATION PRINCIPLE OF CONSTRUCTING MULTICHANNEL AUTOMATIC CONTROL SYSTEMS P. F. Osmolovskiy p 9–13 refs (See N68-36441 23-10)

N68-36440# Joint Publications Research Service, Washington, D. C.
THE RELATION OF CERTAIN QUALITY INDICES IN CONTROLLABLE LINEAR STATIONARY SYSTEMS
L. S. Gnoyenskiy, *In its* Quality Indices and the Iteration Principle in Autom. Control 25 Sep. 1968 p 1–8 refs (See N68-36439 23-10)

A controllable linear stationary system, for which an equation was derived to satisfy certain initial conditions, was investigated. The reference input, which the system must reproduce, is unknown in advance and belongs to the class of functions with a limited rate of variation. Theorems are introduced which relate easily definable parameters of individual elements to the greatest accumulated error of the closed astatic systems and to estimate the effect from introducing correction circuits. D.A.E.

N68-36441# Joint Publications Research Service, Washington, D. C.
THE ITERATION PRINCIPAL OF CONSTRUCTING MULTICHANNEL AUTOMATIC CONTROL SYSTEMS
P. F. Osmolovskiy *In its* Quality Indices and the Iteration Principle in Autom. Control 25 Sep. 1968 p 9–13 refs (See N68-36439 23-10)

The principle of constructing and equalizing the dynamics of a multichannel system designed for precision reproduction of the reference input is considered. Linear differential equations describing the input and output variables are derived for the multichannel, or iteration, system containing n channels. The output of each channel is to be used as a correction for the more precise definition of the useful signal measured with the help of all the preceding channels. The initial relations for analysis and synthesis of iteration systems dealing with noise, and the structural diagrams of iteration systems are mentioned. D.A.E.

N68-36449 Purdue Univ., Lafayette, Ind.
ON THE ANALYSIS AND SYNTHESIS OF CONTROL SYSTEMS USING A WORST CASE DISTURBANCE APPROACH
Alfred Stephen Morse (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-16682

Two problems resulting from a "worst case disturbance" approach to the design of disturbed control systems were studied, and an error analysis problem was formulated to determine the worst case (maximum) value of a system error index due to a bounded disturbance acting on a linear system. This may be accomplished by computing the maximum value of a scalar function of known form with respect to a set of parameters restricted in magnitude. An efficient computational algorithm was developed which may be used in computing the maximum value of this function. The formulation of a worst case disturbance min-max problem is presented. The problem is to determine a controller which will result in the smallest worst case value of a system error index. The relationship between this min-max problem and the differential game is indicated. Min-max problems for general linear systems and three different types of performance indices are investigated. It is shown that the min-max solutions of two of these problems do not always exist. In the third problem investigated, which involves a bounded control and a bounded disturbance, the complete min-max solution is found. Dissert. Abstr.

N68-36451 Denver Univ., Colo.
TRAJECTORY SENSITIVITY OF AN OPTIMAL CONTROL SYSTEM OF FIXED STRUCTURE
Thomas Carl Hendricks (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17106

Necessary conditions, in the form of a two point boundary value problem, are derived for the minimization of a cost functional which includes, in addition to state and control variables, a measure of sensitivity. The plant is described by a set of linear or nonlinear differential equations in which the control function appears linearly, and is constrained to be a constant linear function of the state variables. The solution to the two point boundary value problem is effected by an iterative algorithm which requires integration of four n^{th} order differential equations, matrix inversion, and several matrix integrations at each iteration. The iterative solution to the infinite time regulator problem with sensitivity is given by a purely algebraic algorithm. It is applied to the problem of an optimal design of a flexible booster. Dissert. Abstr.

N68-36591 California Univ., Los Angeles.
CONTROLLABILITY OF DISTRIBUTED PARAMETER SYSTEMS
Charles John Herget (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-797

A summary of the techniques which are applicable to the solution of control systems problems is given. The eigenvalue-eigenfunction expansion method for the solution of homogeneous boundary value problems is used. Problems in which the control appears at the boundary are treated by converting the nonhomogeneous b.v.p. to an equivalent homogeneous b.v.p. by introducing generalized functions. The generalization of the concept of controllability of finite dimensional systems to infinite dimensional systems is given. The pseudo-inverse of a linear operator is defined which is a generalization of that of a matrix for finite dimensional spaces. The necessary and sufficient conditions for the states which are reachable when the control is required to satisfy a norm constraint are given. The conditions are obtained by an application of the moment problem to distributed parameter systems. These results are then used to obtain conditions for complete controllability. Applications of the material are made to specific examples of control systems problems. Dissert. Abstr.

N68-36597*# Arizona Univ., Tucson. Engineering Experiment Station.
GOSPEL—A GENERAL OPTIMIZATION SOFTWARE PACKAGE FOR ELECTRICAL NETWORK DESIGN
L. P. Huelsman Sep. 1968 97 p refs
(Grant NGL-03-002-136)
(NASA-CR-97199) CFSTI: $3.00 CSCL 09C

This report describes GOSPEL, a General Optimization Software Package for ELectrical network design. The package may be applied to a wide range of optimization problems. It consists of a series of subprograms each of which implements a particular random or directed search strategy. The problem to be optimized, and any desired constraints are specified by the user as a separate subprogram. The user has the option of selecting an individual optimization strategy or using a sequence of strategies to attack a given problem. Results of the application of the software package to typical problems are given. Author

N68-36654*# Arizona Univ., Tucson. Engineering Experiment Station.
THE MODELING OF DISTRIBUTED RC NETWORKS
Lawrence P. Huelsman and Stephen P. Johnson Sep. 1968 26 p refs *Its* EES Ser. Rept.-18
(Grant NGL-03-002-136)
(NASA-CR-97201) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A method for modeling the general three terminal distributed network is presented here. Two models to approximate the transmission parameters of a section of the distributed line are introduced. By using an iterative matrix multiplication process, the two models are able to approximate the admittance parameters of the distributed network. The values for the parameters as obtained from the models are compared with the theoretical values for the cases of the uniform and exponentially tapered lines. One of the models is shown to give better overall accuracy than the others. Author

N68-36678 California Inst. of Tech., Pasadena.
THE RESPONSE OF NONLINEAR SYSTEMS TO STOCHASTIC EXCITATION
Harold James Payne (Ph.D. Thesis) 1967 188 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-17071

The response of a dynamical system modelled by differential equations with white noise as the forcing term may be represented by a Markov process with incremental moments simply related to the differential equation. The structure of such Markov processes is completely characterized by a transition probability density function which satisfies a partial differential equation known as the Fokker–Planck equation. Sufficient conditions for the uniqueness and convergence of the transition probability density function to the steady-state are established. Eigenfunction expansions are shown to provide a convenient vehicle for obtaining approximate solutions for first order systems for self-excited oscillators. The first term, an asymptotic expansion of the transition probability density function, is found for self-excited oscillators. A class of first passage problems for oscillators, which includes the zero crossing problem, is formulated. Dissert. Abstr.

N68-36690*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
A NEW ALGORITHM FOR SUBOPTIMAL STOCHASTIC CONTROL
Renwick W. Curry Sep. 1968 10 p refs Presented at the 6th Allerton Conf. on Circuit and System Theory, Urbana, Ill., 2–4 Oct. 1968
(Grant NsG-254-62)
(NASA-CR-97188; RE-49) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A new stochastic control algorithm, called M measurement optimal feedback control, is described for discrete time systems. This scheme incorporates M future measurements into the control

computations: when M is zero, it reduces to the well known open-loop-optimal feedback control; when M is the actual number of measurements remaining in the problem, it becomes the truly optimal stochastic control. This new algorithm may also be used to simplify computations when the plant is nonlinear, when the controls are constrained, or when the cost is nonquadratic. Simulation results are presented which show the superiority of the new algorithm over the open-loop-optimal feedback control. Author

N68-36730# RAND Corp., Santa Monica, Calif.
VARIATIONAL EQUATIONS FOR CERTAIN HOMOGENEOUS AND INHOMOGENEOUS LINEAR SYSTEMS
R. Kalaba, W. Schmaedeke, and B. Vereeke Aug. 1968 23 p refs
(Contract F44620-67-C-0045)
(RM-5690-PR; AD-673342)

In studies of the design, sensitivity, and identification of linear systems, it is necessary to know the changes in the response and in the characteristic frequencies occasioned by a change in a system parameter. This is studied for the vector-matrix problem, and basic systems of differential equations are obtained for the solutions and the eigenvalues. Author (TAB)

N68-36904# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EVALUATION METHODS AND SOME WAYS FOR INCREASING THE RELIABILITY OF AUTOMATIC CONTROL RESULTS [SPOSOBY OTSENKI I NEKOTORYE PUTI POVYSHENIYA DOSTOVERNOSTI REZULTATOV AVTOMATICHESKOGO KONTROLYA]
V. I. Perov and T. D. Zholkover 27 Oct. 1967 11 p refs Transl. into ENGLISH from Vsesoyuznaya Konf. Po Avtomat. Kontrolyu i Metodam Elektr. Izmen. 1966 p 78-84 Presented at the 57th All-Union Conf. on Autom. Control and Methods of Elec. Meas.
(FTD-HT-23-734-67; AD-673390)

Reliability is the decisive factor in automatic control since the information gathered during the control of technological devices must reflect accurately their actual state. The quantitative measure of reliability is expressed by the probability that the result is correct. Of all the possible factors affecting the reliability of automatic control, the authors investigate only the loss of information caused by the quality of the control devices. It is assumed that the initial information on the controlled plant is complete. The newly developed formalism is applied to the control of the operational readiness of devices. Author (TAB)

N68-36979 Technische Hochschule Hannover (West Germany).
ANALYSIS OF LINEAR, TIME-INVARIANT MULTIPLE SYSTEM [ZUR ANALYSE LINEARER, ZEITINVARIANTER MEHRFACHSYSTEME]
Helmut Pralle (Ph.D. Thesis) 1967 92 p refs In GERMAN
CFSTI: $3.00

Mathematical models are formulated and used for controllability analyses on linear, time-invariant multiple systems. For the dynamic stability of model Σ' where $\dot{u}(t) = A\,u(t) + B\,y(t)$ and $x(t) = C\,u(t) + D\,y(t)$ is a minimal polynomial of the symmetry matrix A responsible, and for the stability of the model Σ^2 where $x(s) = F(s)\,y(s)$ is the operator of the transfer function in F(s). Also discussed are parallel and series circuits of multiple systems as well as multiple closed control loop for both model systems. A correlation between the intersecting principle of the one directional control loop and a multiple control loop is established. Transl. by G.G.

N68-37131# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
PROCESS IDENTIFICATION METHOD BASED ON THE Z TRANSFORMATION [METHODE D'IDENTIFICATION DE PROCESSUS PAR LA TRANSFORMATION EN Z]
Gilles Zwingelstein Apr. 1968 35 p In FRENCH; ENGLISH summary
(CEA-R-3508) CFSTI: HC $3.00/MF $0.65

A simple method is described for identifying the transfer function of a linear retardless system, based on the inversion of the Z transformation of the transmittance using a computer. It is assumed that the input and output signals of the circuit considered are of the deterministic type. The study includes: the theoretical principle of the inversion of the Z transformation, details about programming simulation, and identification of filters whose degrees vary from the first to the fifth order. Author (ESRO)

N68-37138# Weapons Research Establishment, Salisbury (Australia).
THE NUMERICAL SOLUTION OF WAVEGUIDE PROBLEMS BY MEANS OF FAST FOURIER TRANSFORMS
C. T. Carson Nov. 1967 13 p refs
(WRE-TN-PAD-137) CFSTI: HC $3.00/MF $0.65

The classical method of boundary matching in conjunction with "Fast Fourier Transforms" permits many problems to be easily solved. The use of Fast Fourier Transforms in the analysis of waveguide problems is described. The method is illustrated by analyzing a section of waveguide containing two identical irises. The waveguide problems to be easily solved. The electric and magnetic field at the input and output of a single waveguide iris is given and the error in the dominant mode is estimated from the residual boundary mismatch. The method permits efficient use of a speed digital computer. Author (ESRO)

N68-37145# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
THE INTEGRATED CIRCUIT LOGIC [LA REALISATION DE FONCTIONS LOGIQUES EN CIRCUITS INTEGRES]
Raymond Joumard May 1968 47 p refs In FRENCH; ENGLISH summary
(CEA-BIB-114) CFSTI: HC $3.00/MF $0.65

The study is essentially limited to the monolithic integrated circuits. A short description of the technology of fabrication explains why the circuitry of the classical transistor gates evolved. The performances of the principal actual families (RTL, DTL, TTL, ECL) are compared. Complex logical operators are mentioned, as well as the limiting factors of their complexity. The field effect transistor circuits (MOST) are then compared to the previous ones, on the point of view of technology, performances advantages. The new methods of interconnection allow or facilitate the construction of big electronic systems. The realizations of integrated circuit systems seems in the present more interesting than the ones made with discrete components and should replace them entirely. Author (ESRO)

N68-37165*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
MAXIMUM LIKELIHOOD IDENTIFICATION OF STOCHASTIC LINEAR SYSTEMS
R. L. Kashyap Aug. 1968 33 p refs
(Grants NGL-15-005-021; NSK GK-1970)
(NASA-CR-97269; TR-EE-68-28) CFSTI: HC $3.00/MF $0.65
CSCL 09C

The maximum likelihood (ML) estimation of the coefficients of a discrete linear system described by a set of coupled difference equations either from the input-output data or from the output data alone is considered. The input and measurements may be noisy. The methods may be noisy. The methods also estimate the covariances of the disturbing noise. Morever, the schemes can be modified to allow for real time operation, but the estimates are no longer ML except in the asymptotic sense. Computational results are given for a third order system. Author

N68-37288 Missouri Univ., Columbia.
SYNTHESIS OF DRIVING POINT IMMITTANCES WITH REACTIVE GYRATORS
Elmer August Hoyer (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-307

The necessary and sufficient conditions are presented for realizing an immittance function as a driving point immittance using the normal passive elements and the reactive gyrator. The reactive gyrator is a new type of gyrator which has recently been defined as a gyrator whose impedance is a function of the complex variable s. In this paper the gyrator impedances are restricted to positive real functions. The necessary conditions are derived from the properties of the loop impedance matrix of a general network which may contain any of the passive elements and reactive gyrators. It is found that the driving point immittances can be of a very general nature with poles and zeros anywhere in the s-plane. However, those occurring on the positive real axis must be of even multiplicity. Dissert. Abstr.

N68-37293*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MULTIVARIABLE CONTROL SYSTEMS [SISTEMY MNOGOSVYAZNOGO REGULIROVANIYA]
M. V. Meerov 1968 294 p refs Transl. into ENGLISH of the book "Sistemy Mnogosvyaznogo Regulirovaniya" Moscow, Izd. Nauka, 1965 Support by NASA and NSF
(NASA-TT-F-435; TT-67-51371) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The fundamental properties of multivariable automatic control systems (MCS) are elucidated and reviewed. The current methods and techniques are assessed and evaluated for the synthesis and analysis of MCS. Mathematical descriptions of some typical MCS, representative of metallurgy and oil industries, are presented. Equations of MCS consisting of single variable subsystems are derived for steady state and transient conditions. The matrix of error coefficients is determined for the case of plant and control coupling of the individual variable. The general structural properties of MCS are investigated with emphasis on infinite gain stability. Noninteraction and variance problems are discussed with respect to structural properties of a certain class of systems. Fixed structure systems with their properties equivalent to adaptive systems and variational aspects of MCS are reported. B.P.

N68-37300# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOELECTRIC FUNCTION CONVERTERS AS A LONG-TERM TREND OF SEMICONDUCTOR ELECTRONICS (OPTOELECTRONICS) [FOTOELETRICHESKIYE FUNKTSIONAL'NYE PREOBRAZOVATELI KAK PERSPEKTIVNOYE NAPRAVLENIYE POLUPROVODNIKOVOY ELEKTRONIKI]
S. V. Svechnikov *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 1–24 refs (See N68-37299 23-09)

Consideration is given to the trend towards microelectronics, particularly optoelectronic devices, such as photoelectrical function converters whereby a light ray is used as a control signal, coupling element, or converting link. Most promising type appears to be of the electroluminescent category, with advantages in long life and microminiature dimensions. The fundamental arrangement of an electroluminescent cell is outlined. Powder phosphors are compared for suitability. Also included is a detailed discussion of elementary optrons, their characteristics and areas of application. Author

N68-37362 Bolkow Entwicklungen K. G., Munich (West Germany).
ANALYSIS OF LINEAR AND NONLINEAR SYSTEMS WITH VARIABLE PARAMETERS BY RANDOM INPUT VARIABLES. PART 2: NONLINEAR SYSTEMS [ANALYSE LINEARER UND NICHTLINEARER SYSTEME MIT VARIABLEN PARAMETERN BEI REGELLOSEN EINGANGSGROESSEN. TEIL 2: NICHTLINEARE SYSTEME]
Fridbert Kilger 31 May 1968 16 p refs In GERMAN Presented at Carl-Cranz-Gesellschaft, Oberpfaffenhofen (W. Ger.), 18–21 Jun. 1968
(RS-33-OE)

The Fokker–Planck–Komogorov equation is used to develop an approximation method to determine linear mean values and focal points for variables of state in excited dynamic systems. Author

N68-37368# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DESIGNING MAXIMUM GAIN AMPLIFIERS USING ACTIVE N-PORT NETWORKS
M. R. Wohlers Oct. 1968 21 p refs To be presented at the 1968 IEEE Intern. Symp. on Circuit Theory, Miami Beach, Fla., Dec. 1968 Submitted for publication
(RM-424)

The theoretical basis is discussed for the design of maximum gain amplifiers using a single two-port active element imbedded in a passive coupling structure. The basis of this technique is a complex normalization procedure for scattering matrices. Author

N68-37396# Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
STATUS OF THE WORK IN THE ELECTRONICS DEPARTMENT [BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN] Quarterly Report, 1 Oct.–31 Dec. 1967
Mar. 1968 46 p refs Partly in ENGLISH and partly in DANISH
(RISO-M-729) CFSTI: HC $3.00/MF $0.65

Progress is reported in a number of reactor-related projects concerning the following: (1) control and display equipment, digital instrumentation, and hardware and software development for the PDP-8/DR 2 computer system; (2) reactor instrumentation for monitoring the concentration of radioactive gases by the modulated precipitation method; (3) instrumentation for measuring the temperature flux in reactor cooling systems; (4) hybrid system interfaces, and development of Fourier analysis and matrix printout programs for the PDP-8 system and the PDP-8/EAI-680 analog computer system; (5) introduction of a function $y = f(x)$ in hybrid computer calculations, a fast-function generator program, and a curve loader program; (6) a review of isotope measuring techniques, and results of Co 60 intercalibration studies. Transl. by K.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-36258# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
SUPERSONIC TURBULENT MIXING. 2: DESIGN AND CONSTRUCTION OF A MACH 3 BLOW-DOWN WIND TUNNEL AND ITS INSTRUMENTATION
D. Azzouz and N. H. Pratt May 1968 54 p refs
(AASU-282)

In the Mach 3 blowdown test facility for supersonic mixing studies, the test section is 0.0635 × 0.0762 m. (2.5 × 3.0 ins.) in cross-section by 0.381 m. (15 ins.) long. The foreign gas is injected parallel to the main stream through a plane slot at the nozzle exit midsection. Instrumentation to measure test section total and static pressure, total temperature, and composition is described. The general features of an optical technique for turbulent fluctuation measurements are indicated. Author

N68-36405# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PERFORMANCE OF A 500-KJ MHD WIND TUNNEL
Wallis R. Grabowsky, Donald A. Durran, and Harold Mirels Mar. 1968 37 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-10)-10; SAMSO-TR-68-222; AD-673476)

The operation of a pulsed MHD accelerator is described for a MHD wind tunnel application. The accelerator is designed to provide a 150% velocity increase (from 15,500 ft/sec to 24,000 ft/sec), at constant enthalpy, of a gas at approximately atmospheric pressure. The accelerator gas source is a hot shot that heats potassium seeded nitrogen to 9000K and 1400 atm. The gas is expanded into a segmented electrode (94 pair) MHD accelerator channel. After tunnel start-up, a 3-msec constant power pulse is switched on the electrodes so that current flow is approximately perpendicular to a quasi-steady 4-Wb/sq m magnetic field. The power-on to power-off velocity ratio at the accelerator exit is determined from changes in the stagnation pressure and open circuit induced potential. Author (TAB)

N68-36479# Lockheed-California Co., Burbank.
THE DEVELOPMENT OF DYNAMIC TAXI DESIGN PROCEDURES Final Report
J. E. Wignot, P. C. Durup, M. A. Gamon, T. A. Ginsburg, and R. Ortasse Jun. 1968 398 p refs
(Contract FA-67-WA-1682)
(FAA-ADS-68-11; AD-673424)

Four forms of dynamic taxi design procedures were developed that consider the three dimensional character of the runway/taxiway surface environment. These procedures along with their potential criteria that were adapted to ensure structural integrity, may be categorized as arbitrary, discrete, deterministic, and statistical. They differ in the assumed model of the taxi environment. Also included is a discussion of parameter variations, procedures for use of the criteria, procedure for the updating of the methods and a complete digital computer program for use in taxi analyses, and for updating the criteria. Author (TAB)

N68-36522*# Washington Univ., Seattle.
THE EFFECT OF THE CONVERGING FLOW FIELD OF A TANDEM TEST SECTION ON LONGITUDINAL STABILITY MEASUREMENTS
Shojiro Shindo and Robert G. Joppa Washington NASA Oct. 1968 27 p refs
(Grant NGR-48-002-010)
(NASA-CR-1198) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Calculations of the internal flow in tandem-test-section wind tunnels have shown the presence of converging flow in the large test section portion between the two contracting sections. Results of analytical and experimental work in a test section having length to height ratio of 3 show that the magnitude of the converging flow and its effect on longitudinal stability of a rigid rotor can be closely predicted. Maximum model sizes and satisfactory testing regions can be identified analytically. A prediction is made for two model sizes tested in a tunnel having length to height ratio of 1. Author

N68-36638# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
SOME CALIBRATION MEASUREMENTS ON THE PLA
K. Batchelor, J. M. Dickson, and S. Norcliffe Nov. 1967 29 p refs
(RHEL/R-110) CFSTI: HC $3.00/MF $0.65

An account is given of a method of setting-up the injector voltage and the radio frequency fields and phases of a three tank 50 MeV proton linear accelerator (the P.L.A.). This calibration technique involves measurements of the beam current and beam energy as a function of the parameters of the machine. The mean energy of the beam was measured by a time-of-flight method and by an energy monitor (based on the range-energy relation in aluminium). The energy spectrum was measured by time-of-flight (at 10 MeV and 30 MeV) and by magnetic analysis. The results are compared with the theory of axial motion of protons in a linear accelerator. It is shown that the best energy stability is achieved when the machine is adjusted to operate with an integral number of phase oscillations in tanks 2 and 3, and that these conditions of operation can be readily achieved by the calibration technique described. Author (NSA)

N68-36670# Sandia Corp., Albuquerque, N. Mex.
HIGH INTENSITY CARBON ARC IMAGING FURNACE
N. R. Keltner Nov. 1967 16 p refs
(Contract AT(29-1)-789)
(SC-TM-67-862) CFSTI: HC $3.00/MF $0.65

Small arc imaging furnaces used for testing small material samples at high heating rates is described. One furnace uses two 60-in. searchlight reflectors for the optical system and a large, high-intensity dc arc for the thermal source to test material samples up to 1 1/4 sq^2 and small component assemblies at high incident heat fluxes. The other furnace uses a commercially available projector and is used to test material samples up to 1/2 in. in dia. NSA

N68-36702# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESONANCE INSTALLATION FOR TESTING FATIGUE OF MATERIALS AT HIGH TEMPERATURES [REZONANSNAYA USTANOVKA DLYA ISPYTANII MATERIALOV NA USTALOST PRI VYSOKIKH TEMPERATURAKH]
A. V. Antonovich 8 Sep. 1967 12 p Trans. into ENGLISH from Zavodsk. Lab. (Moscow), v. 21, no. 2, 1955 p 231–234
(FTD-HT-67-445; AD-673813)

In the apparatus described, a flat test-piece is secured at one end and caused to vibrate in resonance to electromagnetic excitation. The free end of the test-piece forms one plate of an air-dielectric condenser, the other being a fixed plate. The signal from this condenser is suitably amplified and recorded. At the first signs of failure the amplitude of the test-piece oscillation decreases, giving a sharp break on the recording. The test-piece is situated in a furnace with closely-controlled temperature. Author (TAB)

N68-36868# Mound Lab., Miamisburg, Ohio.
INERT GAS GLOVEBOX METALLOGRAPHIC FACILITY FOR RADIOACTIVE MATERIALS
P. A. Tucker [27 Dec. 1967] 21 p Presented at 21st AEC Metallog. Group Meeting, Upton, N. Y.
(Contract AT(33-1)-GEN-53)
(CONF-670533-9) CFSTI: HC $3.00/MF $0.65

A double-faced, stainless steel glovebox, 21 ft long, was installed and successfully operated for metallographic studies of plutonium bearing materials. Continuously flowing dry nitrogen provides an inert atmosphere, and control of the pressure in the glovebox is completely automatic and self-regulating. The glovebox is divided into eight double bays which contain a specimen

mounting press, low speed grinders and polishers, vibratory polishers, ultrasonic cleaners, and facilities for chemical, electrolytic and cathodic etching. A B & L Dynazoom metallograph is mounted inside the glovebox with the trinocular eyepiece pod extending to the outside through a bellows seal. The design and operation of the facility are described. Author (NSA)

N68-36993# General Electric Co., St. Petersburg, Fla. Pinellas Peninsula Plant.

ROTATING SAMPLE HOLDER FOR X-RAY EMISSION SPECTROMETER

N. P. Quebbeman and C. W. Jones 29 Dec. 1967 15 p refs
(Contract AT(29-2)-656)
(GEPP-8; R-67-ND-5) CFSTI: HC $3.00/MF $0.65

A rotating sample holder for X-ray emission analysis of nonhomogeneous samples provides more reliable X-ray emission data by averaging nonhomogeneous irregularities from different sample areas that are observed continuously. The rotating sample holder described was designed and constructed for use on a General Electric XRD-6 X-ray emission spectrometer. Detailed drawings of the sample holder are given. X-ray intensity variation obtained by using the sample holder for continuous sample rotation shows a significant improvement in overall precision when compared to intensity variation obtained by rotation only between readings. Other advantages of using the rotating sample holder are considered. Author (NSA)

N68-37005# European Space Technology Center, Noordwijk (Netherlands).

THE AVERAGE TEMPERATURE ERRORS OF A SATELLITE IN A SPACE CHAMBER DUE TO ENVIRONMENTAL IMPERFECTIONS

J. Doenecke Paris ESRO Jan. 1968 23 p refs
(ESRO-TN-22(ESTEC)) CFSTI: HC $3.00/MF $0.65

Formulae are presented which permit a quick and easy calculation of the average temperature errors of satellites due to some environmental imperfections of the space chamber. The formulae show which of these imperfections have the largest influence on the temperature of the satellite and which should be carefully considered during design to bring the chamber performance closer to real-space environment. For satellite tests the formulae allow one to find out which of the different influences should be considered in the thermal analysis and perhaps calculated in more detail by use of a computer. Author (ESRO)

N68-37039# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

OPEN-AIR IONIZATION CHAMBERS WITH WALLS OF SOFT TISSUE EQUIVALENT MATERIAL FOR MEASURING PHOTON DOSES [CHAMBRES D'IONISATION D'AMBIANCE A PAROIS EN MATERIAU EQUIVALENT AUX TISSUS MOUS POUR LA MESURE DES DOSES ABSORBEES DUES AUX PHOTONS]

Henry Vialettes, Jean- Claude Anceau, Michel Grand, and Géard Petit May 1968 33 p refs In FRENCH; ENGLISH summary
(CEA-R-3540) CFSTI: HC $3.00/MF $0.65

The ionization chambers presented in this report constitute a contribution to research into methods of carrying out correct determinations in the field of health physics. The use of a mixture of teflon containing 42.5 percent by weight of carbon for the chamber walls makes it possible to measure directly the dose absorbed in air through 300 mg/cm^2 of soft tissue and, consequently, the dose absorbed in the soft tissues with a maximum error of 10 percent for photon energies of between 10 keV and 10 MeV. Furthermore, since this material does not contain hydrogen, the chamber has a sensitivity to neutrons which is much less than other chambers. The shape of these chambers has been studied with a view to obtaining a satisfactory measurement from the isotropy point of view; for example for γ radiation of 27 keV, the 3 litre chamber is isotropic to within 10 per cent over 270°, and the 12 litre chamber is isotopic to within 10 per cent over 300°; for 1.25 MeV γ radiation this range is extended over 330° for the 3 litre chamber, and 360° for the 12 litre chamber. This report presents the measurements carried out with these chambers as well as the results obtained. Author (ESRO)

N68-37124# European Southern Observatory, Hamburg (West Germany).

EUROPEAN SOUTHERN OBSERVATORY ANNUAL REPORT, 1967

Mar. 1968 31 p
CFSTI: HC $3.00/MF $0.65

The facilities and organization of the European Southern Observatory at La Silla (Chile) are described. Scientific activities and projects are briefly reviewed and a special mention is made of the astronomical equipment. ESRO

N68-37141# European Space Technology Center, Noordwijk (Netherlands).

THE SIMULATION IN A TEST CHAMBER OF THE THERMAL RADIATIONS IN SPACE

J. Doenecke Paris ESRO Apr. 1968 29 p refs
(ESRO-TM-116(ESTEC)) CFSTI: HC $3.00/MF $0.65

An earth satellite receives thermal radiation from both the sun and the earth. Radiation from the earth is of two kinds - thermal emission and reflected sunlight or albedo radiation. Whereas techniques for simulating solar radiation have been well advanced, the simulation of earth radiation still presents formidable problems of design as well as operation. The bulk of this paper is, therefore devoted to the simulation of thermal radiation coming from the satellite's primary. Of the many practical solutions a 'birdcage' type radiation simulator appears to have more advantages. Simulation of the heat fluxes coming from the earth requires careful calculation in advance and efficient programming of the intensity of the different light sources not only in time but also in direction. Directional programming may become complex since a total of five degrees of freedom must be considered, viz. satellite rotation about itself, about its primary and variation of orbital altitude. The paper shows that accurate simulation of the thermal radiation from the satellite's primary is not possible in principle. The reason for this is that the geometry of radiation in the chamber case must necessarily be different from the orbit case because the primary is scaled down whereas the satellite is not. Author (ESRO)

N68-37152# Weapons Research Establishment, Salisbury (Australia).

ACCEPTANCE TESTING OF THE COLD AIR SUPPLY TO THIRD STAGE AND SATELLITE, LAUNCHER 6A, WOOMERA

A. C. Coulson Dec. 1967 9 p refs Prepared for ELDO
(WRE-TN-DWD-8) CFSTI: HC $3.00/MF $0.65

The results of testing the combined umbilical mast cold air supplies for the third stage and satellite are reported. Author (ESRO)

N68-37228# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.

STEP BY STEP INTEGRATION OF THE BEAM CURRENT OF A PULSED ACCELERATOR [INTEGRATION COUP PAR COUP DU COURANT DE FAISCEAU D'UN ACCELERATEUR PULSE]

Thank Khai Truong 1967 101 p refs In FRENCH
(RI-1967/12)

An integrator that can be used with all the measurement devices of the Orsay linear accelerator, even the magnetic torus, was constructed. The electronic device for the measurement of the charge by sampling was described, and its curcuits are given. The use of a sampling system with a magnetic torus meter is discussed. The principle of the system is given, and its operation in aperiodic and oscillating regimes is described. NSA

N68-37259*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PRELIMINARY OPERATION OF THE LEWIS MAGNETOHYDRODYNAMIC GENERATOR FACILITY
Lester D. Nichols, James L. Morgan, Lawrence A. Nagy, Joseph M. Lamberti, and Robert A. Ellson Washington Oct. 1968 26 p refs
(NASA-TN-D-4867) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The closed loop facility has been designed to study the feasibility of an argon–cesium MHD generator. The construction details, performance, and some preliminary research data are discussed. The facility has operated for several hours at the following conditions: argon flow rate, 1.8 kg/sec; Mach number, 0.3 to 0.5; stagnation temperature, 2100°K. Thus far, open circuit voltages equal to 60 percent of theoretical value (at 50 V) were measured. In addition short circuit currents up to 0.8 A (per electrode pair) were measured. This is in agreement with the calculated value using equilibrium conductivity. Leakage currents prevented better performance. Author

N68-37377# European Southern Observatory, Hamburg (West Germany).
EUROPEAN SOUTHERN OBSERVATORY BULLETIN NO. 3
Feb. 1968 56 p Partly in FRENCH and partly in ENGLISH
CFSTI: HC $3.00/MF $0.65

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2. THE ROAD TO LA SILLA H. O. Voigt
3. THE WATER AND POWER SUPPLY FOR LA SILLA S. Klingberg
4. THE BUILDING FOR THE 1.5 m SPECTROGRAPHIC TELESCOPE J. Ramberg
5. THE SPECTROGRAPHIC TELESCOPE OF 1.52 m DIAMETER AND ITS EQUIPMENT Ch. Fehrenbach (In French)
6. THE 2 m ESO ALUMINIZING PLANT J. Ramberg
7. METEOROLOGICAL OBSERVATIONS ON LA SILLA IN 1966 A. B. Muller
8. THE COMPARISON OF THE SEEING BETWEEN MORADO AND LA SILLA J. B. Irwin

N68-37397*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-51, VOLUME 3 FOR THE PERIOD APRIL 1 TO MAY 31, 1968. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Jun. 1968 374 p refs
(Contract NAS7-100)
(NASA-CR-97170; JPL-SPS-37-51, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22

Supporting research and advanced development is a review of engineering and scientific work performed to include systems engineering guidance and control propulsion, space sciences and telecommunications. For individual titles see N68-37397–N68-37421.

N68-37407*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENVIRONMENTAL AND DYNAMIC TESTING
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 97–100 refs (See N68-37397 23-11)

Described is a low frequency plane-wave sound generator and impedance-measuring device which is designed to determine the acoustic impedance in terms of sound pressures and volume velocities as measured at the input of an attached acoustic element. The device provides undistorted sinusoidal acoustic signals in the range from 10 to 400 Hz. It establishes the acoustic pressures, particle velocities, and the phase relationship between the pressures and velocities at the input to the acoustic element under investigation. These same parameters are determined, either by measurement or by analytical prediction, at the output of the acoustic element. With these data, an accurate determination of the element impedance properties can be made at a given frequency and the element response characteristics determined. This process is repeated at enough frequencies within the frequency band of interest to provide adequate resolution. Design and calibration data on the device are included. Data obtained from calibration runs indicated that accurate acoustic impedance information can be obtained. Calibration runs also verified the mechanical design of the device as well as the accompanying mathematical analysis. Use of this device requires accurate methods of data acquisition, such as digital readout of phase, acceleration, and acoustic pressure, and maintaining undistorted input signals at the output of the device. Possible applications of the proposed device in environmental qualification testing of spacecraft and subsystems are discussed. S.C.W.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-36011*# Cincinnati Univ., Ohio. Inst. of Space Sciences.
SURVEY AND EVALUATION OF SUPERSONIC BASE FLOW THEORIES
P. W. Carpenter and W. Tabakoff [1968] 196 p refs
(Grant NGR-36-004-014)
(NASA-CR-97129) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Base flow theories are considered to be divided into four main groups, namely semi-empirical theories, those based on the Chapman–Korst model, integral methods, and multimethod base flow theories which attempt to take the dynamics of the recirculating flow into account. Each of these categories is considered in detail, important theoretical contributions being summarized, criticized and evaluated. A new model for the reattachment process is introduced, and it is inferred that the Chapman–Korst reattachment criterion is not a good approximation for turbulent or hypersonic flows, and that the reattachment process is independent of conditions downstream of the rear stagnation point. A new interpretation of the variation of base pressure with Reynolds number is introduced. It is concluded that for practical purposes the original Korst and Chapman theories with their extensions and some modifications are the most useful. Author

N68-36013 Stanford Univ., Calif.
THE ROLE OF DIFFUSIVITY IN TURBULENT DISPERSION
Gary Don Bizzell (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-17398

The Lagrangian description of diffusion in the presence of fluid motions has been analyzed using the concepts of a Markov

random process. The solution for the concentration field, resulting from a point source placed at the origin as the initial condition, is represented by an integral of a probability density function over the space of particle paths connecting the origin with the Eulerian independent variables of position and time, $(\underline{X},t)$. The functional integral for the concentration results from repeated application of the Chapman-Kolmogorov relation from the theory of stochastic processes and represents a conditional probability of finding a particle at $(\underline{X},t)$ under the condition that it began its trajectory at the origin. Considerable effort is given to the physical meaning of this result, and applications of these results is made to the Townsend–Saffman problem for interactions of molecular diffusion with turbulent dispersion. Dissert. Abstr.

N68-36024 California Univ., Berkeley.
AN INVESTIGATION ON THE LAMINAR FLOW AROUND THE TRAILING EDGE OF A FLAT PLATE
Ralph Ta-shun Cheng (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 No. 68-45

Studies of the incompressible fluid motion around a two-dimensional flat plate aligned parallel to the oncoming free stream are thoroughly reviewed and extended. Emphasis is placed on the detailed study of the fluid motion in the neighborhood of the trailing edge. A modified Oseen linearization is used to simplify the Navier–Stokes momentum equations and the stream function equation. These equations are then solved by the Wiener–Hopf technique. The solution of the momentum equations confirms the existence of a singularity at the trailing edge, and the distribution of shear stress on the plate is in agreement with a recent numerical solution. The stream function equation, however, is only formally solved. Finally, an iterative procedure is proposed to solve the viscous fluid motion around an arbitrary two-dimensional finite object. Dissert. Abstr.

N68-36025 State Univ. of Iowa, Iowa City.
FREE-SURFACE EFFECTS ON BOUNDARY-LAYER SEPARATION ON VERTICAL STRUTS
Shin-Kien Chow (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-16785

This dissertation represents an investigation of free surface effect on boundary layer separation on vertical struts piercing a free surface. The investigation consists of two phases. In the theoretical phase, the theory of infinitesimal waves was used to derive the velocity potential for the flow about the strut, generated by a distribution of semi-infinite vertical line sources below the free surface of an otherwise-undisturbed semi-infinite fluid. This line-source distribution was determined by solving an integral equation of the first kind for the two-dimensional (infinite strut) problem, and then assuming that the same distribution could be used when a free surface is present. Piezometric-head distributions (surface elevation) along the strut at the free surface were calculated for twelve Froude numbers and the separation points were calculated by the modified Stratford method. Dissert. Abstr.

N68-36042 Stanford Univ., Calif.
A NON-LINEAR THEORY OF TAYLOR INSTABILITY OF SUPERPOSED FLUIDS
Nanguneri Ramier Rajappa (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-17488

A study is presented on the two dimensional Taylor instability of superposed fluids of infinite depth and on the same problem when the fluids occupy a cylindrical tube. The analysis is made by means of a nonlinear theory. The problem of Taylor instability of an accelerated two dimensional interface between two superposed fluids of great depth is found to be a singular perturbation problem. The fluids are taken to be inviscid. The problem is solved by the method of strained coordinates. The oscillation or the growth of the interface is found to depend not only on the initial wave number but also on the initial amplitude of the disturbance or imperfection of the interface. The results obtained by the theory for the motion of the bubble in a cylindrical tube are in good agreement with the experiments when surface tension and curvature of the interface are included. Dissert. Abstr.

N68-36051 Tulane Univ., New Orleans, La.
STUDIES IN THE DYNAMIC BEHAVIOR OF A SWITCHING JET IN A MODEL BISTABLE FLUID ELEMENT
Prateen Vinduprasad Desai (Ph.D. Thesis) 1967 76 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17907

An experimental investigation of the transient behavior of a jet treated as a two dimensional, incompressible, and turbulent jet of air in a wall reattachment type of bistable fluid element is made. The jet is switched from the left wall where it is attached to the opposite right wall by introducing a pneumatic control flow pulse at right angles to the jet nozzle axis. Corona discharge probes are used for taking the measurements at several locations in the flow field. Four probes are used for simultaneous recording of the switching event at four locations. From these measurements response time is calculated as eight milliseconds, and the total switching time as twenty milliseconds. It is observed that switching is completed at the end of the diffuser section before the same occurs in the mixing region. A description of the jet position during the switching sequence is given on the basis No. 37–51, Vol. Experimental optimization of the best suited bistable element for a specific purpose can be obtained using the experimental technique and set-up developed. Dissert. Abstr.

N68-36053 Washington Univ., St. Louis, Mo.
ON THE SHAPE AND VELOCITY OF SINGLE AIR BUBBLES RISING IN SMALL DIAMETER TUBES IN STAGNANT AND FLOWING LIQUIDS
Wayne Joseph Drda (Ph.D. Thesis) 1967 321 p
Available from Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No. 67-17166

The effect of proximity to confining surfaces on the rise velocities of single air bubbles in liquids are presented. The phenomenon was studied by using vertical tubes of small diameter through which liquid flowed with velocities rahging from 0 to 24 cm/sec. A discussion of the variation of bubble shape and velocity with bubble volume and a comparison of this data with that taken in larger systems is included. A correlation of the bubble shape data using dimensional analysis is presented. An equation for estimating the velocity of single bubbles rising in stagnant liquids in small diameter tubes is presented. A method for calculating the growth rate of a vapor bubble in forced convection boiling in small tubes is proposed. Dissert. Abstr.

N68-36062 Michigan Univ., Ann Arbor.
A STUDY OF THE RHEOLOGY OF SUSPENSIONS OF ROD-SHAPED PARTICLES IN NAVIER-STOKES LIQUID
Leo Floyd Carter (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17739

Suspensions tested are composed of microscopic glass rods suspended in a high viscosity polybutene oil. The cone and plate attachment of the Weissenberg rheogoniometer is employed for all rheological tests, which include measurements of normal and shear stresses for steady shear flow, measurements of stresses for oscillatory shear and combined steady plus oscillatory shear flow, as well as measurement of a direction dependent time effect. A

theory for dilute suspensions of rigid ellipsoids is developed which yields the complete stress tensor for the cases of maximum and minimum energy dissipation. Results reveal the presence of significant normal stresses as well as mild shear thinning for steady shear flow. Tests involving periodic flows indicate that elastic effects are not important. The theoretical results predict the observed dependence of the measured shear stresses and normal-forces on concentration and shear rate, and also predict particle shape dependence of the shear stresses. Modification of the theoretical results for dilute suspensions yields a parameter which predicts the particle shape dependence of the measured normal-forces. Dissert. Abstr.

N68-36071*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DETAILED DESCRIPTION AND RESULTS OF A METHOD FOR COMPUTING MEAN AND FLUCTUATING QUANTITIES IN TURBULENT BOUNDARY LAYERS

Ivan E. Beckwith and Dennis M. Bushnell Washington Oct. 1968 118 p refs

(NASA-TN-D-4815) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The conservation equations for mass, mean momentum, and turbulent kinetic energy for the incompressible turbulent boundary layer have been solved by an implicit finite-difference procedure. Mathematical models developed by Glushko for the production, dissipation, and diffusion of the turbulent kinetic energy in the flat plate turbulent boundary layer have been modified and used to calculate a nonequilibrium turbulent boundary layer subjected initially to a large adverse pressure gradient followed by a run of constant pressure. Comparisons of both mean and fluctuating flow properties have indicated generally good agreement between the calculated results and experimental measurements of Goldberg. The best overall agreement with data was obtained by reducing the scale of turbulence in the outer part of the boundary layer to about 70 percent of the flat plate values as used by Glushko. The calculations have indicated that further simple modifications to the turbulence scale function and to some of the mathematical models for the turbulence correlation terms should improve the accuracy of predictions for the Goldberg data. The authors have shown that the predictions in good agreement with data were obtained for other arbitrary pressure distributions. Author

N68-36088 Stanford Univ., Calif.

ON THE KINETIC PROBLEM OF SHOCK TUBE FLOW

John Earl Yates (Ph.D. Thesis) 1967 132 p

Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17529

The present study treats the classical shock tube problem within the framework of the kinetic theory of gases. The initial value problem is formulated for the Boltzmann equation and a discussion of previous work, present objectives and some of the mathematical subtleties is given. The Boltzmann equation is cast in the form of a complete integral equation that incorporates the initial data. A solution valid for small time is obtained by formal application of an asymptotic limit process. The first order solution satisfies the so called collisionless Boltzmann equation and is obtained in terms of the initial data function f_o. The second order solution reduces to a multiple quadrature on f_o and contains the initial collisional effects. The first and second order solutions are derived explicitly and interpreted in detail at the kinetic level. Many of the results are descriptive and must perforce be omitted from the abstract. Dissert. Abstr.

N68-36108# McDonnel-Douglas Co., Santa Monica, Calif. Fluid Physics Branch.

DISCONTINUOUS SUPERSONIC FLOW PAST AN ABLATING WAVY WALL

G. R. Inger Sep. 1968 16 p refs

(DAC-62375)

Closed-form solutions were obtained for the pressure and streamline disturbance fields in a discontinuous two-layer supersonic inviscid flow past a wavy wall with pressure-following surface injection, using linearized theory as a basis. The analysis provides a highly idealized physical model of turbulent boundary layer flows over ablating irregular surfaces. The results showed that the disturbance reflection-refraction mechanism associated with the presence of the contact surface between the two uniform streams can cause a significant shift of the peak wall pressure toward the surface valleys. The maximum value of this phase shift was shown to occur at a certain optimum ratio of boundary layer thickness to surface wavelength. Author

N68-36114*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

A TIME DEPENDENT APPROACH TO THE NUMERICAL SOLUTION OF THE FLOW FIELD ABOUT AN AXISYMMETRIC VEHICLE AT ANGLE OF ATTACK Final Report

J. Xerikos and W. A. Anderson Jun. 1968 67 p refs

(Contract NAS8-21141)

(NASA-CR-61982; DAC-62279) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A three-dimensional inviscid flow field analysis for treating axisymmetric configurations at angle of attack has been formulated and mechanized in the form of a Fortran IV UNIVAC 1108 computer program. A time-dependent floating mesh technique is employed which involves use of a conditionally stable, first-order finite difference representation of the governing equations. Provisions are included for treating an axisymmetric flare located on the vehicle afterbody. Computations have been performed for sphere and sphere-cone configurations as well as for a hemi-cylindrical flare in a uniform free stream. A significant feature of the results is that the three-dimensional mode of calculation does not appear to introduce unstable behavior in cases which can be run successfully at zero angle of attack. The applicable range and accuracy of the computer program are discussed with respect to free stream and vehicle geometry parameters. Author

N68-36127 Stanford Univ., Calif.

ON THE STRUCTURE OF AN EDGETONE FLOW FIELD

Gilbert Rolland Stegen (Ph.D. Thesis) 1967 54 p

Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17511

An edgetone flow field was experimentally investigated using hot-wire anemometry. The variation of the phase and amplitude of transverse velocity was measured along the centerline of the edgetone system. The measurements were made at several wedge heights during both Stage 1 and Stage 2 operation for a fixed slit Reynolds number of 635. The measured variation of phase does not agree with the theoretical predictions. The local propagation speed and wavelength are deduced from the phase measurements. The propagation speed and wavelength are shown to vary rapidly along the centerline of the edgetone system during Stage 1 operation. These quantities show little spatial dependence during Stage 2 operation. Finally it is shown that the variation of propagation speed in the edgetone flow field can be partially explained by examining similar measurements in a sound exciting free jet. The spatial variation of the amplitude of the fundamental and harmonic frequencies was measured. The spatial variation of the amplitude is found to depend on the parameter x/h, and the stage of operation. The variation of growth rate does agree with the results based on the stability theory of free jets. Dissert. Abstr.

N68-36128 California Inst. of Tech., Pasadena.
LAMINAR BOUNDARY LAYERS IN THE NEIGHBORHOOD OF ABRUPT SPATIAL DISTURBANCES
Thomas Janney Tyson (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17077

Supersonic, steady laminar boundary layers exhibiting strong local interaction with the outer flow are considered. The general behavior of such flows on a flat adiabatic plate are studied by means of the moment method equations and by finite difference solutions of the full boundary layer equations, including the transverse momentum equation. A one-parameter family of free interaction solutions is generated with the finite difference approach. These include separated reverse flow solutions. The infinite plate solution is established from the leading edge through weak interaction by both techniques. Expansive corner flow solutions are developed using both methods. In the moment method study the nature of the leading edge, Blasius point and critical line singularities is developed by numerical investigation. Dissert. Abstr.

N68-36144 Michigan Univ., Ann Arbor.
ON THE KINETIC THEORY OF THE LORENTZ GAS
Walter R. Hoegy (Ph.D. Thesis) 1967 175 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17778

A study is made of the nonequilibrium behavior of the classical Lorentz gas. The particle distribution is found to satisfy a dynamical equation that generalizes the Lorentz-Boltzmann equation. The first term in a density expansion gives the Enskog generalization of the Lorentz-Boltzmann collision integral. The analysis is carried out by expanding the system streaming operator in a cluster expansion and a Husimi expansion. Use of the binary collision expansion allows an interpretation of the terms in the collision operators. The higher density collision operator terms are shown to diverge in the long time limit. The divergence is removed by a ring diagram technique, and a simple prescription is given for the general renormalized terms. A formula is obtained for the Lorentz gas conductivity using the renormalized collision operator. Dissert. Abstr.

N68-36149 Michigan Univ., Ann Arbor.
ACCELERATION OF A HYPERSONIC BOUNDARY LAYER APPROACHING A CORNER
George Robert Olsson (Ph.D. Thesis) 1967 172 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17824

A theoretical description of the acceleration of a laminar boundary layer approaching a sharp corner is obtained for the limit of large Reynolds number and large external Mach number. Various asymptotic representations applicable in a first approximation are derived. Due to the sizable pressure gradient in a neighborhood of the corner, the viscous effects, in a first approximation, are found to be confined to a sublayer that is thin compared with the boundary-layer thickness. The flow outside the sublayer is characterized by two distinguished limits. In a first outer limit a streamwise coordinate of the order of magnitude of the external Mach number times the boundary-layer thickness is held fixed. The streamline deflection and normal pressure gradient are relatively small, and the approximate equations may be integrated directly. A streamwise coordinate of the order of magnitude of the boundary-layer thickness is held fixed in a second outer limit. Dissert. Abstr.

N68-36160# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE VISCOUS INCOMPRESSIBLE FLOW PAST A CIRCULAR CYLINDER AT MODERATE REYNOLDS NUMBERS
Robert L. Underwood May 1968 55 p refs
(Contract AF 49(638)-1274)
(SUDAAR-349; AFOSR-68-1664; AD-673906)

An accurate description of the flow field about a cylinder is found possible with a semi-analytical solution of the full Navier-Stokes equations. The method of series truncation is employed to reduce the governing partial differential equations of motion to a system of ordinary differential equations which can be integrated numerically. This method, which has been applied to the hypersonic blunt-body problem by previous investigators with great success, is essentially a successive-approximation procedure which treats an elliptic partial differential equation as if it were parabolic or hyperbolic. The dependent variable is expanded in one co-ordinate, and backward influence in the resultant system of ordinary differential equations is prevented by series curtailment. Results are given for Reynolds numbers between 0.4 and 10.0 (based on diameter); however, the method can be applied to both higher and lower Reynolds numbers without modification. An accurate prediction of the Reynolds number at which separation first occurs behind the circular cylinder is made; this separation Reynolds number is found to be 5.75. Over the entire Reynolds-number range investigated, characteristic flow parameters such as the drag coefficient, pressure coefficient, standing-eddy length, and streamline pattern compare favorably with available experimental data and numerical-solution results. It is concluded that the semi-analytical method of series truncation permits accurate determination of the flow field about a circular cylinder at moderate Reynolds numbers without resorting either to full-numerical solution or to experiment. Author (TAB)

N68-36200# Iowa Inst. of Hydraulic Research, Iowa City.
AN EXPERIMENTAL STUDY OF SHEAR-STRESS VARIATION ON A SERIES-60 SHIP MODEL
Kent T. S. Tzou Feb. 1968 32 p refs
(Contract Nonr-1611(05))
(IIHR-108; AD-672565)

A study of the change in water-surface profile with Froude number near the stern of a series-60 model, the shear-stress distribution on the after body, and a discussion of the possible laminar boundary-layer effects are presented. The results suggest that the sinuous trend of the viscous-drag curve is attributable to the change in surface configuration near the stern and the shear-stress distribution on the ship hull, and cannot be attributed to the presence of a laminar boundary-layer. Author (TAB)

N68-36222 Stanford Univ., Calif.
AN EXPERIMENTAL INVESTIGATION OF THE EDGETONE FLOW FIELD
William Laurie Shields (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17505

The velocity field of a stage 1 edgetone jet has been measured using linearized constant temperature hot wire anemometers. Measurements of the u and v components over a complete edgetone cycle have been made throughout the jet region. A complete time/space history of the velocity in the jet has thus been obtained. The Reynolds number of the flow, based upon slit width and mean speed at the slit, was fixed at 630. The jet profile at the slit was parabolic. The jet profiles were found to maintain a smooth shape throughout the cycle, except very near the edge at the instant the jet impinged on the edge. It also was found that flow speeds did not vary strongly along the moving jet centerline except near the edge at the instant of impingement. It was concluded that the strong fluctuations reported previously are primarily due to the jet sweeping past the fixed hot wire rather than to speed fluctuations along the jet. Dissert. Abstr.

N68-36223 State Univ. of Iowa, Iowa City.
THE FLOW OF FLUIDS THROUGH EXPANSIBLE TUBES
Robert Gene Sheppard (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-16839

Data are presented from experimental runs for steady and non-steady flow of fluids through expansible silicone rubber tubes. The non-steady flow data indicate that the velocity of propagation of a pressure pulse moving down a tube is larger than values predicted by the Moens equation. An equation is obtained to predict the pressure drop for steady irrotational, viscous flow, which includes the effect of secondary flow (the radial component of velocity). Under the conditions at which the data were taken, the effect of secondary flow was found to be insignificant. Pressure drops predicted by this equation agree to within about one percent of the experimental values. For non-steady flow, two simultaneous non-linear partial differential equations are derived for one-dimensional viscous flow of a fluid through an expansible tube. These equations are presented in a form suitable for solution on a digital computer. Dissert. Abstr.

N68-36261# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
PRESSURE-FLOW-DISPLACEMENT CHARACTERISTICS OF A PERIPHERAL JET FLUID SUSPENSION
H. H. Richardson, W. A. Ribich, and Y. Ercan 1 Jun. 1968 68 p refs
(Contract C-85-65)
(DSR-76110-7; PB-176136) CFSTI: HC $3.00/MF $0.65

An experimental investigation of the pressure-flow-displacement characteristics of a peripheral jet fluid suspension is summarized. The effects of nozzle pressure ratio, Reynolds number, base recess and jet nozzle size on equilibrium and non-equilibrium characteristics are presented for a 30 deg. nozzle angle. It is shown experimentally that the effects of geometric scaling can be studied adequately by varying ambient pressure level. Inviscid performance theories were found to overestimate equilibrium cushion pressures from 40% at low jet thicknesses, low Reynolds numbers and high hover heights to less than 5% at opposite conditions. Mass flow rates and power requirements were found to be within 15% of the inviscid Barratt theory for the larger jet widths tested. Theories for non-equilibrium jet behavior were found to be inadequate for predicting pressure-flow and displacement-flow sensitivities needed in dynamic models of peripheral jet devices. Experimental values of pressure-flow-displacement sensitivities derived from nonequilibrium performance data are presented. Author (USGRDR)

N68-36283 California Inst. of Tech., Pasadena.
THE DRIVING MECHANISM OF STRONGLY DEVELOPED TAYLOR VORTEX FLOW
Pieter Wesseling (Ph.D. Thesis) 1967 59 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17060

The purpose of this thesis is to explain how strongly developed Taylor vortex flow is kept in motion. On the basis of this explanation approximate torque calculations for high Taylor numbers have been made. Agreement with experiment is satisfactory. Axial symmetry is assumed throughout. Dissert. Abstr.

N68-36307 California Inst. of Tech., Pasadena.
TURBULENT BUOYANT JETS INTO STRATIFIED OR FLOWING AMBIENT FLUIDS
Loh-Nien Fan (Ph.D. Thesis) 1967 212 p
Available from Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-17061

Theoretical and experimental studies were made on two classes of buoyant jet problems, namely: 1) an inclined, round buoyant jet in a stagnant environment with linear density-stratification; 2) a round buoyant jet in a uniform cross stream of homogeneous density. Using the integral technique of analysis, assuming similarity, predictions can be made for jet trajectory, widths, and dilution ratios, in a density-stratified or flowing environment. Such information is of great importance in the design of disposal systems for sewage effluent into the ocean or waste gases into the atmosphere. Studies of a buoyant jet in a stagnant environment were extended to the Morton type of analysis to cover the effect of the initial angle of discharge. Numerical solutions are presented for a range of initial conditions. Laboratory experiments were conducted for photographic observations of the trajectories of dyed jets. The problem of a buoyant jet in a uniform cross stream was analyzed by assuming an entrainment mechanism based upon the vector difference between the characteristic jet velocity and the ambient velocity. Dissert. Abstr.

N68-36328 California Univ., Los Angeles.
A STUDY OF ROTATIONAL RELAXATION IN A LOW-DENSITY HYPERSONIC FREE JET BY MEANS OF IMPACT-PRESSURE MEASUREMENTS
Bernard Lefkowitz (Ph.D. Thesis) 1967 64 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-225

A hypersonic free jet of nitrogen was probed using a pitot tube. The impact pressure was found to deviate from predictions of inviscid theory for free jets (after corrections for shock detachment, nozzle boundary layer, and viscous effects at the probe) in regions of rotational nonequilibrium. The rotational relaxation time was inferred from the impact-pressure data by the use of the sudden freezing $|DT/Dt| = T/\tau_r$. The observed relaxation time was interpreted using a relaxation model in which N_r is constant with value unity over the range from 10°K to 100°K and a collision frequency which includes only those collisions for which $r \leq 0.993\sigma$. The temperature dependence of the collision frequency for this model is significantly different than the rate based on a viscosity cross section. Dissert. Abstr.

N68-36340# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEPARATION OF A THREE-DIMENSIONAL BOUNDARY LAYER [OTRYV TREKHMERNOGO POGRANICHNOGO SLOYA]
V. S. Avduevskii and K. I. Medvedev 14 Sep. 1967 22 p refs
Transl. into ENGLISH from Mekhan. Zhidkosti i Gaza, Akad. Nauk SSSR, no. 2, 1966 p 19–26
(FTD-MT-67-36; AD-673461)

The line of separation of a three-dimensional boundary layer on an arbitrary curvilinear surface is a special flow line on the surface of a body separating the region of separation and being the line of runoff for the limiting lines of current. Proceeding from the condition of equality to zero of frictional force in the projection on the normal to the line of separation, expressions are selected for criteria of three-dimensional separation. The position of the line of separation is determined from the solution of an ordinary differential equation. An analysis is conducted of the different cases of separation on the surface of a cylinder with slip and on the surface of sharp cones streamlined by supersonic flow at an angle of attack. The position of lines of separation was experimentally determined by the runoff of thin liquid films applied to the surface. It is shown that the separation on a sharp cone appears on the line $x = pi$ with values of the parameter $K = 0.85$. Author (TAB)

N68-36343*# IIT Research Inst., Chicago, Ill.
ANALYTICAL INVESTIGATION OF INCOMPRESSIBLE TURBULENT SWIRLING FLOW IN PIPES

Avelino P. Rochino and Zalman Lavan Washington NASA Sep. 1968 137 p refs
(Grant NsG-694)
(NASA-CR-1169) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Turbulent swirling flows in ducts were investigated analytically using mixing length theories. The governing equations for the mean flow were derived using Taylor's modified vorticity transport theory and the concept of isotropy of the transport coefficients. The similarity theory of von Karman was extended to swirling flows in a cylindrical geometry considering a three-dimensional fluctuating velocity field. The resulting similarity conditions were used to formulate the expression for eddy diffusivity in the entire flow field except for a small region near the pipe wall where a mixing length expression analogous to that assumed by Prandtl for parallel flow in channels was used. The tangential equation of motion was then solved numerically to study the decay of angular momentum in a swirling flow field inside a stationary pipe. It is pointed out that for pure rotational as well as irrotational flow, some of the similarity conditions become indeterminate suggesting that the said formulation may not be valid for these situations. Author

N68-36357 Oklahoma Univ., Norman.
COMPRESSIBILITY FACTORS AND VIRIAL COEFFICIENTS FOR THE HELIUM-NITROGEN SYSTEM BETWEEN −160° AND −190°C UP TO 700 ATM
Kenneth Richard Hall (Ph.D. Thesis) 1967 138 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-16731

Major modification of the temperature bath extended the range of applicability to −190°C and 700 atmospheres. The temperature control was ± 0.005°C across the Burnett apparatus in the new configuration. A technique was also developed for employing valves completely immersed in the cryostat. An extensive study of polynomial approximations for infinite series yielded a scheme for assigning realistic variances to the polynomial coefficients as compared with the series coefficients. This allows choice of optimal virial coefficients from the experimental compressibility data. Finally, an optimal search routine was developed to reduce the Burnett data to the compressibility factors. This was essentially a problem in non-linear curve fitting. Dissert. Abstr.

N68-36365# Rocketdyne, Canoga Park, Calif.
THE EFFECT OF CHARGE TRANSPORT ON THE DISINTEGRATION OF LIQUID JETS Interim Technical Report, 1 Jun. 1967–30 May 1968
A. L. Huebner 31 May 1968 70 p refs
(Contract N00014-67-C-0474)
(R-7487; AD-673860)

Disintegration processes occurring with charged liquid jets of several different fluids were examined. A range of fluid and electrical properties were spanned. High-speed photographic techniques were used to determine the effect of charging on disintegration of the jet, the size distribution of the drops formed, and the velocities of the drops. Electrification alters the disintegration pattern of the jet by enhancing the instabilities, as well as introducing new instabilities in many cases. The size distribution of the drops formed from the electrified jets is significantly altered in the direction of lower mean sizes. Drop velocities increase and are changed in direction, as a result of both electrical repulsion forces and the reduction in size. Author (TAB)

N68-36372 California Univ., Los Angeles.
A THEORETICAL INVESTIGATION OF SWIRLING FLOWS THROUGH A NOZZLE
William Stanley King (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17362

A theoretical inquiry into the nature of swirling inviscid nozzle flows is presented. The general theory of swirling flows is developed, and first applied to the special case of incompressible nozzle flow. An exact solution for the flow through a nozzle with small area changes is presented and discussed. It is found that the flow characteristics depend strongly on the magnitude of a swirl parameter β which is the ratio of the initial tangential velocity to the initial axial velocity. If a critical value of this parameter is exceeded, reverse flows occurs, and standing waves are present in the nozzle. A simplification called the quasi-cylindrical approximation which is valid for gradual changes in the nozzle's area is developed, and several examples of flows with different initial circulation distributions are presented. The results of the investigation are applicable to basic studies of engineering devices such as the vortex fluid amplifier, the vortex gaseous core nuclear reactor, and the vortex stabilized arc jet. Dissert. Abstr.

N68-36379# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF INTEGRAL RELATIONS IN THE THEORY OF TURBULENT JET FLOWS [METOD INTEGRALNYKH SOOTNOSHENII V TEORII TURBULENTYKH STRUINYKH TECHENII]
A. S. Ginevskii Oct. 1967 41 p refs Transl. into ENGLISH from Prom. Aerodinamika (USSR), no. 27, 1966 p 5–30
(FTD-MT-24-173-67; AD-673657)

An isothermal, turbulent, plane, axisymmetric jet is investigated using Karman-type integral methods. Both the initial and main flow of the jet are analyzed as the jet issues into a wake whose speed is either slower or faster than the jet speed. Also investigated are expanding and converging flows of a radial-slot type jet. Author (TAB)

N68-36380# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VANE MACHINES IN JET APPARATUSES
V. S. Baykov and Yu. N. Vasilev 20 Oct. 1967 29 p Transl. into ENGLISH from Lopatochnye Mashiny i Struynye App. (USSR), no. 1, 1966 p 235–258
(FTD-MT-24-185-67; AD-673658)

Contents: On one possibility of increasing the stage efficiency of a gas ejector; On calculating the throttling characteristics of a gas ejector with negative ejection coefficients. TAB

N68-36383# National Aeronautical Establishment, Ottawa (Ontario).
PARAMETRIC APPROXIMATION FOR INCOMPRESSIBLE LAMINAR BOUNDARY LAYERS WITH SUCTION OR INJECTION
Y. Y. Chan Apr. 1968 34 p refs
(NRC-10286) CFSTI: $3.00

The parametric method of Loitsianskii in the theory of laminar boundary layers is extended to include suction or injection at the surface. The universal equation is generalized to include the suction parameters. A power series solution of the universal equation in terms of two parameters, namely, the external velocity gradient and the surface suction parameters, is obtained. The accuracy of the present method is checked against some exact solutions and is found to be in good agreement up to the order considered in the formulation. Author

N68-36396# Politecnico Di Torino (Italy). Istituto Di Meccanica Applicata.
SHOCK WAVE PRECURSOR MEASUREMENTS. PART 2: EXPERIMENTAL APPARATUS AIR TEST RESULTS
Ario Romiti Nov. 1967 19 p refs
(Grant AF-EOAR-26-66)
(AFOSR-68-1772; TN-39; SR-3; AD-673893)

The pneumatic and electronic devices which have been used for precursor measurements are here described. Experiments are reported that were carried out in order to check the validity of the measure method. Finally, the precursor number densities, concentrations and source functions are given in diagrams for various test pressures and shock speeds as functions of the distance from the shock front. Author (TAB)

N68-36397# Politechnico Di Torino (Italy). Instituto di Meccanica Applicata.

INCOMPRESSIBLE LAMINAR SKIN-FRICTION LAW

Gianni Jarre Jan. 1968 23 p refs

(Grant AF-EOAR-26-66)

(AFOSR-68-1771; TN-40; SR-4; AD-673894)

The skin-friction law is directly derived from the outer velocity law, avoiding any detailed analysis of velocity profiles or of boundary layer thicknesses. A rough solution of the kinetic-energy integral equation yields the structure of the law, and a critical screening of accurate solutions yields the correct coefficients. The skin-friction law so derived describes: the stagnation-point flow, very well; the pressure minimum flow, perfectly; the setting of separation, accurately; the crossing of separation, realistically. Slightly modified, it also describes the similar flows and evidences the deep difference between similar and nonsimilar separation. Author (TAB)

N68-36401 Stanford Univ., Calif.

SOME ASPECTS OF WAVE MOTION IN STABLY STRATIFIED FLUIDS

Russ Erik Davis (Ph.D. Thesis) 1967 105 p

Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17408

Two separate problems concerning different aspects of wave motion in stably stratified fluids were studied and the results are presented. Consideration is given to a new type of solitary wave motion in incompressible fluids of nonuniform density which was investigated experimentally and theoretically. If a fluid is stratified in such a manner that there are two layers of different density joined by a thin region in which the density varies continuously, this type of wave propagates along the density gradient region without change of shape. Also conducted was a theoretical and experimental investigation of the stability of periodic internal waves. From the analysis it is found that if a primary wave, with wavenumber k_0 and frequency ω_0, is perturbed by two infinitesimal wavelike disturbances with wavenumbers k_1 and $k_1 + k_0$ and frequencies ω_1 and $\omega_1 + \omega_0$, exponential growth of these disturbances will take place under certain conditions. Dissert. Abstr.

N68-36412*# Massachusetts Inst. of Tech., Cambridge.

A STUDY OF FLUID DYNAMICS OF GASEOUS NUCLEAR ROCKETS Quarterly Progress Report, 1 Jul.–30 Sep. 1968

W. S. Lewellen 30 Sep. 1968 18 p refs

(Contract NSR-22-009-288)

(NASA-CR-97113; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Empirical correlations were made of experimental data found in the available literature in order to provide the information required to predict the flow pattern in any given vortex tube. When laminar flow theory was compared with experimentally obtained velocity profiles, the resultant curves were found to be in close agreement; and differences between theory and experiment were attributed to the turbulence for the high Reynolds number experiments. Ratio of effective eddy viscosity to actual laminar velocity was also plotted, and the slight differences were attributed to turbulence as well as to approximations used in making calculations. M.W.R.

N68-36458*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-DENSITY, LEADING-EDGE BLUNTNESS, AND ABLATION EFFECTS ON WEDGE-INDUCED LAMINAR BOUNDARY LAYER SEPARATION AT MODERATE ENTHALPIES IN HYPERSONIC FLOW

C. L. W. Edwards and John B. Anders Washington Oct. 1968 31 p refs

(NASA-TN-D-4829) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A study of real gas wedge induced laminar boundary layer separation has been made. The investigation was conducted in low-density air on a highly cooled flat-plate model with interchangeable leading edges and various trailing edge flap angles. All tests were conducted in the Langley 1-foot hypersonic arc tunnel at a nominal free stream Mach number of 12, free stream unit Reynolds numbers from 1.1×10^4 to 2.7×10^4 per foot (3.6×10^4 to 8.9×10^4 per meter), and dimensionless stagnation enthalpies from 39.0 to 72.4. The extent of separation was found to increase with increasing leading edge bluntness at these test conditions. Significant low density effects are shown to delay the onset of separation in comparison with what would be expected from predictions by a strong interaction theory. The direct effect of mass addition on the extent of separation through ablative leading edges was found to be negligible; however, an indirect effect on the extent of separation due to leading edge regression was found to be significant. Author

N68-36561 National Aerospace Lab., Tokyo (Japan).

STUDY OF HIGH TEMPERATURE FLOW AROUND BODY USING AN ARC-DRIVEN SHOCK TUBE

Riichi Matsuzaki and Chiharu Kamise 1968 17 p refs In JAPANESE; ENGLISH summary

(NAL-TR-153) CFSTI: $3.00

Experimental studies are described of the luminous flow around a body in a high temperature and low density flow generated in an arc driven shock tube. Uniformity of the velocity of luminous shock wave front along the tube axis is better than that in an ordinary electric shock tube without diaphragm. In fact, a uniform flow is established in the present shock tube that is confirmed to be satisfactory in the present experiment. Luminous flow regions ahead of cylinders and spheres of various diameters were observed by means of time integrated photographs. In order to investigate the thickness and the profile of the luminous flow region, a microphotometric tracing was performed along the forward stagnation streamline. It is found that the relative thickness of the luminous flow region (properly defined as the thickness of the luminous flow region divided by the body diameter) is not constant but increases as the body diameter decreases. For a constant body diameter, the thickness becomes large with the decrease of the initial pressure of the driver section. These effects were ascribable to rarefaction of the flow generated in the present shock tube. Development of a luminous far wake behind the cylinder was also observed, and the observed profiles of the wake shock front and viscous wake region are discussed. Author

N68-36562# Aeronautical Research Labs., Melbourne (Australia).

SHOCK WAVE INTENSIFICATION THROUGH A SHAPED CONTRACTION

A. D. McEwan Apr. 1968 27 p refs

(ARL/A-298) CFSTI: HC $3.00/MF $0.65

An experimental study was made of the intensification of a plane normal shock-wave passing through a 16:1 two-dimensional contraction of parabolic shape. For entering shocks of Mach number from 1.09 to 2.43 in air, the gain in shock strength exceeds, by a significant amount, the predictions of the one-dimensional unsteady theory. Previously published data on the mach reflection of plane shocks on inclined surfaces is examined in the context of shock intensification through a contraction. The possibility is noted of convergent shapes designed for optimum strengthening of an entering shock. Author

N68-36610# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MOLECULAR MIXING VELOCITY ALONG THE BASIC SEGMENT OF A TURBULENT JET [O SKOROSTI MOLEKULYARNOGO SMESHENIYA NA OSNOVNOM UCHASTIKE TURBULENTNOI STRUI]
A. G. Prudnikov and N. A. Zamyatina 31 Aug. 1967 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (USSR), no. 3, 1966 p 104–110
(FTD-HT-67-212; AD-673651)

The molecular homogeneity of a combustible mixture controls the reaction rate in diffusional combustion, and it is, therefore, the most important parameter in this process. Experiments were made to study the mixing of two concentrical jets and the molecular homogeneity in the mixing zone. A cold air stream containing NaNO3 vapors was discharged into a concurrent stream of hot combustion products generated by the combustion of a gasoline-air mixture. The hot flow had a temperature of 1650-1800K and a velocity in the 65-90 m/sec range. The cold air stream was injected through uninsulated tubes of 10, 4, and 2 mm diameter located concentrically in the hot flow. The cold gas stream at the outlet from the tube had temperatures of 1100-1400K and velocities of 50-240 m/sec. The light intensity of the hot sodium atoms was determined from photographs and correlated with flow parameters to obtain values for the dispersion and the homogeneity of the gas. The dispersion was found to depend not on the jet diameter but only on the velocity ratio. It had a minimum when both jets had equal velocities. It is concluded that the width of the turbulent-molecular mixing zone monotonically changes from a linear law at a velocity ratio of 0.3 to a parabolic law at a velocity ratio of 1. Mixing to molecular homogeneity takes 2-4 times longer than turbulent mixing. Author (TAB)

N68-36614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE MICROSTRUCTURE OF A TURBULENT JET IN A WAKE [ISSLEDOVANIE MIKROSTRUKTURY TURBULENTNOI STRUI V SPUTNOM POTOKE]
A. S. Ginevskii, L. I. Ilizarova, and Yu. M. Shubin 14 Sep. 1967 21 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Izv. Mekh. Zhidkosti i Gaza (USSR), no. 4, 1966 p 81–88
(FTD-HT-67-311; AD-673388)

The microstructure of the main part of an axisymmetric turbulent jet in a wake flow is investigated experimentally over a wide range of the wake parameter m = u sub delta/u sub 0 (0.04, 0.21, 0.4, 0.52), where u sub delta - is the velocity of wake flow and u sub 0 is the mean velocity at the nozzle exit. Measurements were made with Disa Elektronik apparatus (a constant-temperature anemometer), including two amplifiers and a correlator. The velocity profiles of three components of fluctuating velocity and Reynolds stress were measured in the main part of the jet. The values of the mean velocity and two components of fluctuating velocity were measured at a large number of points on the jet axis. The measured profiles of Reynolds stress are compared with corresponding profiles calculated from an experimentally determined mean velocity profile by means of turbulent boundary layer equations. The correlation coefficient of longitudinal components of fluctuating velocity in one section of the jet was measured for two values of m and the variation of the integral scale of turbulence across the jet was determined. The results obtained here illustrate the effect of the parameter m on the characteristics of a turbulent jet in wake flow. Author (TAB)

N68-36864*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME METHODS OF SOLVING A NONLINEAR INTEGRO-DIFFERENTIAL EQUATION ON THE THEORY OF JET FLOW OF AN IDEAL FLUID [NEKOTORYE METODY RESHENIYA ODNOGO NELINEINOGO INTEGRO-DIFFERNTSIALNOGO URAVNENIYA TEORII STRUI IDEALNOI ZHIDKOSTI]
G. N. Pykhteev 19 Sep. 1967 32 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 2, 1966 p 72–86
(FTD-HT-23-496-67; AD-673750)

The proposed methods are applied to jet flows along a curved wall and to jet flows of a heavy liquid with rectilinear boundaries. The limits of applicability for these methods are discussed. The majorant equations for the two classes of jet flow have the same form. In order to use these methods effectively, exact and approximate methods for computing the given integrals must be developed. Author (TAB)

N68-36679# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE RESISTANCE OF A FLAT PLATE LOCATED NORMAL TO THE FLOW OF GREATLY RAREFIED GAS [O SOPPOTIVLENII PLOSKOI PLASTYI RASPOLOZHENNOI NORMALNO K POTOKU SILNO RAZREZHENNOGO GAZA]
V. A. Perepukhov 15 Sep. 1967 20 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 5, no. 5, 1965 p 844–853
(FTM-MT-67-33; AD-673760)

A method is presented for calculating the aerodynamic properties of a flat plate of any given shape at arbitrary values of the accommodation coefficient in a rarefied gas flow. First-time collisions of free-stream and reflected molecules are considered, with the effect of attenuation of the reflected flow on free-stream flow taken into account. The presence of the arbitrary accommodation coefficient means that the velocity of a reflected molecule cannot be neglected at the time of collision with a free-stream molecule, and this leads to a complex collision integral. The method is based on calculating the function of the effect of molecules reflected from an elementary surface upon the aerodynamic characteristics of the other elementary surface. A detailed scheme for computer calculation by means of the Monte Carlo method was developed. The results of numerical calculations of the aerodynamic characteristics of a square plate for various values of the accommodation coefficient are presented as an illustrative example. Author (TAB)

N68-36725# Los Alamos Scientific Lab., N. Mex.
TRANSPORT OF TURBULENCE ENERGY DECAY RATE
Francis H. Harlow and Paul I. Nakayama 20 Feb. 1968 9 p refs
(Contract W-7405-ENG-36)
(LA-3854) CFSTI: HC $3.00/MF $0.65

The second of two previously proposed turbulence transport equations is here derived so as to determine the variation of several of the universal functions. The derivation also extends the usefulness of the equation, strengthens their validity, and clarifies the interpretations of the turbulence fields variables. Author (NSA)

N68-36754*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WAKE AND INTERREFLECTION EFFECTS IN THE CALCULATION OF FREE MOLECULAR FLOW DRAG COEFFICIENTS
James O. Ballance 31 Jul. 1968 51 p refs
(NASA-TM-X-53642) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A Monte Carlo technique has been applied to the problem of calculating drag coefficients in free molecule flow where one body shields a second body from the incoming flow and where multiple collisions with the bodies are allowed. First, the applicability of the Monte Carlo approach is demonstrated showing that it produces compatible results with other theories considering various parameters such as the accommodation coefficient, the mode of reflection, the angle of attack, etc. Then, a system of two coaxial

circular discs are studied showing the effects of shielding of one body by another, and the effects of multiple collision. Although the interaction effects of the system always tended to decrease the drag coefficients, for practical purposes, they could be ignored. It was also shown (1) that hyperthermal flow-type calculations can be modified slightly to assume some small divergence in the flow which is dependent on the speed ratio and (2) that modifications will provide very good agreement to the wake effects observed in the Monte Carlo solution. Author

N68-36823# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONDITIONS OF THE FLOW OF A LIQUID AROUND LARGE GAS BUBBLES [REZHIM OBTEKANIYA ZHIDKOSTYU GAZOVYKH PUZYRKOV BOLSHIKH RAZMEROV]
B. B. Brandt and D. I. Perazich Aug. 1967 10 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 10, no. 2, 1966 p 197–200
(FTD-MT-24-204-67; AD-673414)

An equation is given which makes it possible to calculate the change of dimension of a gas bubble as it moves through a liquid. It is experimentally shown that the flow of a liquid past large deformed gas bubbles is of the undetached type. Author (TAB)

N68-36828 Catholic Univ. of America, Washington, D. C.
CONSTITUTIVE RELATION OF SUSPENSIONS
Hyok Sang Lew (Ph.D. Thesis) 1967 167 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-17151

The constitutive relation of suspension composed of Newtonian fluid and rigid spherical particles with low concentration are studied. By expanding the velocity and pressure of the fluid involving a small rigid sphere into a power series of the smallness parameter, which is the radius of the sphere divided by the characteristic length of the shearing state of the flow, the Navier–Stokes equation is decomposed into a set of coupled linear differential equations of various orders of the smallness parameter. These equations up to the third order are solved for an unbounded flow system involving a single small rigid suspended sphere. The fundamental results of this study are applied to a fully developed flow of a suspension in a pipe. It is then shown that the pressure is higher near the center and lower near the wall of the pipe. It is also shown that a suspended sphere in a Poiseuilles flow lags behind the flow while it rotates with the same angular velocity as that of the fluid. Dissert. Abstr.

N68-36862# Aeronautical Research Labs., Melbourne (Australia).
A REVIEW OF FLOW AROUND CIRCULAR CYLINDERS, STRANDED CYLINDERS AND STRUTS INCLINED TO THE FLOW DIRECTION
D. E. Glenny Oct. 1966 37 p refs
(ARL/ME-284) CFSTI: HC $3.00/MF $0.65

A review of currently available data on flow about cylindrical bodies inclined to the free stream was carried out. The data obtained are summarized for the steady and fluctuating forces in the Reynolds number range, $10^4 < Re < 10^6$, angles of inclination, $0° < \Theta < 90°$, and indicates those regions where data are lacking. Author

N68-36884# General Electric Co., Schenectady, N. Y. Research and Development Center.
REFLECTION OF GASEOUS DETONATION WAVES
F. J. Martin Dec. 1967 40 p refs
(KAPL-M-7026) CFSTI: HC $3.00/MF $0.65

For the design of pressure vessels to contain explosive gas mixtures in which detonation may occur, it is desired to be able to estimate the pressure-time trace and the impulse following reflection of the detonation at a rigid wall. It is shown that bounds on these quantities can be calculated from known properties of the detonation wave and the flow field behind it, when certain arbitrary conditions are imposed on the reflected shock and the flow behind it. The bounds are shown to be consistent with overall momentum requirements. The pressure behind the reflected wave is shown to fall off inversely with time to the power n where $2 < n \leq 3$. Time is measured from the point of initiation of detonation. The equations for the calculations are given together with a computer program written in BASIC language. Author (NSA)

N68-36897# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CIRCULATION OF RECOMBINATION RATE CONSTANTS OF DIATOMIC GASES BY MACH NUMBER OF THE STREAM AT THE OUTPUT OF A SUPERSONIC NOZZLE [RASCHET KONSTANTY SKOROSTI REKOMBINATSII DVUKHATOMNYKH GAZOV PO CHISLU MAKHA POTOKA NA VYKHODE SVERKHZVUKOVOGO SOPLA]
G. N. Nikolaev 8 Sep. 1967 10 p refs Transl. into ENGLISH from Issled. Po Fiz. Gasodinamike, Akad. Nauk SSSR, Energeticheskiy Inst. (Moscow), 1966 p 165–169
(FTD-HT-23-692-67; AD-673394)

The effects of intramolecular processes, such as dissociation, recombination, and excitation of vibration on supersonic gas flows, is of great interest in studying high temperature gas dynamics. In particular, the recombination rate of a dissociated gas had been previously found to affect the expansion in a supersonic nozzle. Therefore, in the present experimental analysis, an attempt was made to calculate the recombination rate from measurements of one of the parameters, in this case, the Mach number, of a gas (oxygen or hydrogen) discharging from a supersonic nozzle. Using an approximate method based on the concept that the chemical composition is frozen instantaneously, the relationships between the Mach number and the nozzle cross section, which varied according to a hyperbolic law, were calculated and plotted at 8500K and 4200K. It was proved that the recombination rate constant can be calculated from the experimentally determined Mach number at the nozzle outlet. Author (TAB)

N68-36921# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
LOCAL VOID FRACTION MEASUREMENT IN AIR WATER FLOW WITH A HOT-FILM ANEMOMETER [MESURE DU TAUX DE VIDE LOCAL EN ECOULEMENT DIPHASIQUE EAU-AIR PAR UN ANEMOMETRE A FILM CHAUD]
Jean Marc Delhaye May 1968 60 p refs In FRENCH; ENGLISH summary
(CEA-R-3465) CFSTI: HC $3.00/MF $0.65

The experimental knowledge of the local void fraction is basic for the derivation of the constitutive equations of two-phase flows. This report deals with measurements of the local void fraction based on the use of a constant temperature hot-film anemometer associated with a multichannel analyzer. After determining the void fraction profile along a diameter of a vertical pipe (40 mm I.D.), in which air and water flow upwards, the void fraction averaged over the diameter is compared with the average value measured directly by a γ-ray method. Author (ESRO)

N68-36941# National Physical Lab., Teddington (England). Ship Div.
A NUMERICAL SOLUTION OF AXISYMMETRIC CAVITY FLOWS, PARTS 1 AND 2
C. Brennen Jul. 1968 49 p refs
(NPL-SHIP-114) CFSTI: HC $3.00/MF $0.65

A method is developed for the relaxation solution of axisymmetric cavity flows, based on a method by Woods for flows

in axisymmetric ducts. The solution is carried out in the ϕ, ψ plane where a simple rectangular boundary and mesh system can be used. The determinacy of the problem in the ϕ, ψ plane is discussed and the paper indicates the numerical method successfully adopted. The stagnation and separation singularities are given special attention. Author (ESRO)

N68-36984 Aerodynamische Versuchsanstalt, Gottingen (West Germany).
THEORY OF OSCILLATING ELONGATION PROFILES DURING COMPRESSIBILITY SUBSONIC FLOW. PART 1: DERIVATION OF CLOSED ANALYTICAL SOLUTION FOR INTERFERENCE PRESSURE [THEORIE DES SCHWINGENDEN STRECKENPROFILS BEI KOMPRESSIBLER UNTERSCHALLSTROEMUNG. TEIL 1: HERLEITUNG DER GESCHLOSSENEN ANALYTISCHEN LOESUNG FUER DEN STOERDRUCK]
H. G. Kuessner 4 Apr. 1967 35 p refs In GERMAN
(Rept.-67-J-03, Pt. 1) CFSTI: $3.00

Euler's equations of motion for a compressible friction-free fluid are used to integrate aerodynamic interference pressure as function of slipstream of oscillating linear slender profiles. The Green function of the oscillating linear profiles is obtained by using an elliptical coordinate system to construct the integral kernel of the interference pressure. G.G.

N68-37043# Oak Ridge National Lab., Tenn.
POTENTIAL VORTEX FLOW ADJACENT TO A STATIONARY SURFACE
G. D. Kidd, Jr. and G. J. Farris 20 Jun. 1968 38 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2262) CFSTI: HC $3.00/MF $0.65

The equations describing the flow produced by the interaction of a potential vortex with a stationary surface are solved by means of similarity transformations. In this analysis, where the only restriction is that the flow be similar, solutions are obtained for tangential Reynolds numbers up to 4.75. The numerical method employed is based on a recently proposed technique for solving ordinary differential equations with asymptotic boundary conditions. Author (NSA)

N68-37061# Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION OF THE COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH AIR INJECTION
L. O. F. Jeromin 1968 64 p refs Supersedes ARC-28549; see X67-16729
(ARC-R&M-3526; ARC-28549) CFSTI: HC $3.00/MF $0.65

The compressible turbulent boundary layer on a flat plate with air injection has been investigated experimentally. Boundary-layer developments were measured at Mach numbers of 2.5 and 3.5 for the case of zero injection and each of three different injection rates, with and without heat transfer. The free stream Reynolds numbers were 5×10^7 per meter for a Mach number of 2.5 and 4.7×10^7 per meter for a Mach number of 3.5. All the more interesting boundary-layer parameters like momentum thickness, displacement thickness, boundary-layer thickness, boundary-layer shape parameter and the skin-friction coefficient were determined from the measured profiles and are given. ESRO

N68-37067*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES OF FLOW DISTORTION IN THE TAILPIPES OF HYDROGEN PEROXIDE GAS GENERATORS USED FOR JET ENGINE SIMULATION
Leland B. Salters, Jr. and Nicholas C. Chamales Washington Oct. 1968 51 p refs
(NASA-TM-X-1671) CFSTI: HC $3.00/MF $0.65 CSCL 21E

An investigation was made of the effect of variation in configuration of hydrogen peroxide decomposition engines on the jet exhaust flow characteristics. Sixteen configurations of hydrogen peroxide decomposition engines were tested under static conditions over a jet exit total pressure to static pressure ratio range from 1.2 to 4.6 using hydrogen peroxide of approximately 90.5 percent concentration. Jet exit total pressure flow distortion was found to vary inversely with the contraction ratio of the tailpipe. The propellant distribution plate and catalyst bed retainer plate designs also influenced exhaust flow patterns. Flow straightener plates were effective in reducing flow distortion in the jet exhaust. Author

N68-37146# National Physical Lab., Teddington (England). Numerical and Applied Mathematics Div.
ON FLUIDS WITH CONVECTED ELASTICITY
F. J. Lockett and S. Zahorski (Polish Acad. of Sci.) Apr. 1968 12 p refs
(NPL-MA-71) CFSTI: HC $3.00/MF $0.65

It is shown that, in steady viscometric flows, incompressible Rivlin-Ericksen fluids cannot be distinguished from fluids possessing a generalized form of convected elasticity. This also applies to incompressible third-grade fluids in arbitrary flows, or fourth-grade fluids in two-dimensional flows, provided they have analytic deformation histories. Since Rivlin-Ericksen fluids are inelastic under a well-known definition of an elastic fluid, we conclude that the behavior predicted for fluids with convected elasticity is not uniquely associated with elastic properties for the flows considered. Author (ESRO)

N68-37198*# Ampex Corp., Redwood City, Calif. Research and Advanced Technology Div.
ON FLUID INERTIA EFFECTS IN INFINITELY WIDE FOIL BEARINGS
A. Eshel 15 Jul. 1968 25 p ref Sponsored jointly by DOD, AEC, and NASA
(Contract Nonr-3815(00)(X))
(NASA-CR-97260; RR-68-15; AD-672792) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Equations for a foil over a lubricating film in which the effects of fluid inertia are taken into account are derived. Approximate solutions showing the effect of inertia and fluid compressibility are obtained. The effect of inertia is to increase the fluid film thickness. Author (TAB)

N68-37199# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
EVALUATION OF THE APPLICABILITY OF WATER MODEL TESTING TO LIQUID METAL ENGINEERING PROBLEMS
H. J. Borneburg 26 Feb. 1968 97 p refs
(Contract AT(04-3)-700)
(LMEC-68-4) CFSTI: HC $3.00/MF $0.65

The extent to which water model testing can be substituted for liquid metal tests in investigating liquid metal flow problems is examined by applying dimensional analysis. Problems considered are flow through piping systems, pumps, bearings, and fluid seals, flow problems connected with liquid metal heat transfer, cavitation, vortexing, and transients. Author (NSA)

N68-37207 Louisiana State Univ., New Orleans.
A THEORETICAL STUDY OF THE FORCE EXERTED BY A VISCOUS FLUID ON AN OSCILLATING CYLINDER
John Stephen Bosnak (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17305

When a circular cylinder performs free translational sinusoidal oscillations in a viscous fluid, the force exerted on the cylinder by the fluid causes damping and a change in the period of oscillation. The damping and change in period can be expressed in terms of a damping parameter proportional to the logarithmic decrement, and a period parameter proportional to the change of the period. These parameters are first introduced by Stokes in his study of the low amplitude oscillations of a cylinder in a viscous fluid. In this study it is shown that the change in the damping parameter with amplitude of oscillation can be explained by a simple flow model based on the assumed occurrence of separation when the amplitude exceeds $\sqrt{\lambda}a$, where λ is the viscous penetration depth and a is the cylinder radius. Two separation models are presented: a potential flow model and a visous flow model Dissert. Abstr.

N68-37231*# Melpar, Inc., Huntsville, Ala. Analytical Dynamics Lab.
STOCHASTIC STABILITY OF THE LIQUID FREE SURFACE IN VERTICALLY EXCITED CYLINDERS
R. R. Mitchell Falls Church, Va. May 1968 92 p refs
(Contract NAS8-21112)
(NASA-CR-98009) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Sufficient conditions for the stability of the plane free surface of a heavy liquid enclosed in a partly filled prismatic cylinder which is subjected to a random vertical acceleration are determined. The concepts of moment stability and sample stability are defined and their interrelationships are studied via a series of examples. These definitions are then applied to the free surface stability problem and conditions for second moment stability are determined for three types of random vertical acceleration: Gaussian white noise, a narrow band noise, and a Gaussian noise with a general power spectral density function satisfying certain conditions. It is then shown that the conditions derived for second moment stability actually yield sample stability. Natural frequencies and mode shapes for some of the common prismatic cylinder configurations, a discussion of sample stability and second moment stability for a first order system, and some interesting results concerning the stabilization of an inverted pendulum by subjecting its base to a random vertical displacement are presented in the appendices. Author

N68-37232*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
INTERACTIONS OF A SHOCK WAVE WITH AN ENTROPY DISCONTINUITY
Elizabeth Cuadra Feb. 1968 129 p refs
(Contract NAS8-21100)
(NASA-CR-98035; WR-67-17) CFSTI: $3.00 CSCL 20D

High levels of pressure fluctuation have been observed on surfaces beneath shock waves in turbulent flows. One of the flow disturbances which can contribute to this pressure field is the interaction of entropy disturbances (fluctuations of temperature or density at constant pressure) with the shock. It is shown that this interaction can generate fluctuating pressure fields of the same order as those caused by shock-turbulence interactions. Numerical results (based on theory by C.T. Chang) are presented for the flow field resulting from a two-dimensional step discontinuity of entropy interacting with an infinite plane shock. Downstream perturbations of pressure, vorticity and entropy are presented in parametric form for normal shocks and for oblique shocks generated by wedge flow, for $1.4 \leq M_\infty \leq 10$ and wedge half angles 4 to 30 degrees. Expressions are derived for the Fourier synthesis of a random isotropic field of entropy waves interacting with a shock, but the random case has not been carried to the point of numerical results. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-36048 California Univ., Berkeley.
MICROWAVE ABSORPTION BY STRATOSPHERIC OZONE
William Mac Kenzie Caton (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-5021

An estimate of the magnitude and the variation with frequency of the atmospheric ozone based on typical data for the variation of ozone concentration, temperature, and pressure with height above sea level shows that the absorption produced by the atmospheric ozone is small compared to the absorption produced by the other atmospheric constituents. The ozone absorption appears as relatively narrow lines against a background of the wings of the lines produced by the other atmospheric constituents. The ozone lines were studied in absorption against the sun's radiation and in emission at the temperature of the atmosphere. When they are studied in absorption the problem is essentially the detection of a small quantity in a large one. To eliminate the large effect of the sun's radiation, a special radiometer was built with provision to switch the local oscillator output rapidly between two frequencies, on and off 37.836 gc/sec line. An absorption cell filled with an ozone-oxygen mixture was used to test this receiver in the laboratory. In addition to successfully detecting the 37.836 gc/sec ozone line in absorption with the special radiometer, the 30.056 gc/sec ozone line was detected in emission with a Dicke type radiometer. Dissert. Abstr.

N68-36107*# Oregon Univ., Portland. Dept. of Geology.
[PLAGIOCLASE THERMOMETRY OF IGNEOUS ROCKS] Semiannual Status Report, 1 May 1967–31 Oct. 1968
Daniel F. Weill 31 Oct. 1968 5 p
(Grant NGR-38-003-009)
(NASA-CR-97153) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Research activities are reported on the plagioclase–silicate liquid equilibrium system, and melt crystal element fractionation in basic magmatic systems. Results confirm that the distribution of Na, Si, Al, and Ca between plagioclase and coexisting silicate melt can be correlated with temperature of equilibration in magmatic systems ranging from granitic to basaltic. Linear regression curves, dependent upon water pressure, are used to make this correlation. These curves show that the dominant effect of increasing the water pressure is to shift a given plagioclase–liquid partition to lower temperatures. B.P.

N68-36120 Stanford Univ., Calif.
THE ELECTRICAL COUPLING MECHANISM IN THE IONOSPHERE
Dickson De-Jane Fang (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 67-17420

Since the longitudinal conductivity is at least four orders of magnitude higher than the transverse conductivities in the ionosphere, the geomagnetic field lines are ordinarily assumed to be electrical equipotential lines. With this assumption there would be no electric field strength reduction along the geomagnetic field lines. The purpose of this report is to examine the validity of this assumption and to study the significance of the reduction of the electric field strength in the ionosphere along the geomagnetic field lines. An analytic method has been formulated to calculate the reduction in electric field strength. A given source of electric field

at a certain layer will be coupled to a higher (or lower) layer along the geomagnetic field lines if the field strength reduction is small. The coupling mechanism is examined for various latitudes and heights, as well as for differences in the scale of the source of the electric field. Dissert. Abstr.

N68-36146 Oregon State Univ., Corvallis.
ON THE ABYSSAL TEMPERATURES OF THE WORLD OCEANS
Boyd Ellertson Olson (Ph.D. Thesis) 1968 166 p
Available from Univ., Microfilms: HC $7.80/Microfilm $3.00
Order No. 67-17881

The energy of geothermal heat flowing through the sea bottom is extremely small; nevertheless, this energy is not insignificant in the circulation of the bottom water. Calculations indicate that in the deep basins of the South Atlantic the water volume transport necessary to remove this heat is at least one-tenth of the total northward flow of Antarctic Bottom Water. Plots of mean values of near bottom salinity and oxygen versus mean potential temperatures help to trace the movement of the bottom water. Geothermal and adiabatic warming associated with downslope flow combine to produce a deep temperature minimum in portions of most of the deep basins of the world. Adiabatic or near adiabatic temperature gradients have been measured near the bottom in many of these basins. Evidence of superadiabatic gradients from temperature measurements made with reversing thermometers is inconclusive; however, careful measurements with closely spaced thermometers suggest that such gradients do exist over vertical distances of a few hundred meters in some of the deepest basins. Dissert. Abstr.

N68-36174*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEODETIC SATELLITE RESULTS DURING 1967
Charles A. Lundquist ed. 29 Dec. 1967 357 p refs
(Contract NSR-09-015-018; Grant NGR-09-015-002)
(NASA-CR-97155; SAO Special Rept.-264) CFSTI: HC $3.00/MF $0.65 CSCL 08E

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1. EVOLUTION AND INTEGRATION OF GEODETIC RESEARCH AT SAO C. A. Lundquist p 1–16 refs (See N68-36175 23-13)

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3. DYNAMICAL DETERMINATION OF STATION LOCATIONS USING GEOS 1 DATA E. M. Gaposchkin p 25–42 refs (See N68-36177 23-13)

4. IMPROVED VALUES FOR COEFFICIENTS OF ZONAL SPHERICAL HARMONICS IN THE GEOPOTENTIAL Y. Kozai p 43–56 refs (See N68-36178 23-13)

5. THE EARTH'S GRAVITATIONAL FIELD AS DERIVED FROM A COMBINATION OF SATELLITE DATA WITH GRAVITY ANOMALIES W. Koehnlein p 57–72 refs (See N68-36179 23-13)

6. THE DETERMINATION OF THE RADIUS OF THE EARTH AND OTHER GEODETIC PARAMETERS AS DERIVED FROM OPTICAL SATELLITE DATA G. Veis p 76–99 refs (See N68-36180 23-13)

7. JUPITER, FLORIDA, INTERCOMPARISON EXPERIMENT E. Horine, J. Latimer, D. Le Conte, and M. Wolf p 101–128 refs (See N68-36181 23-13)

8. DATA PREPARATION AND EVALUATION FOR GEOS 1 TRACKING SYSTEMS L. H. Solomon p 129–143 refs (see N68-36182 23-07)

9. REDUCTION AND ACCURACY OF BAKER-NUNN OBSERVATIONS OF GEOS 1 K. Lambeck and L. J. Mc Grath, Jr. p 145–150 refs (See N68-36183 23-07)

10. GEOS 1 ORBITAL ELEMENTS AND OBSERVATIONS B. R. Miller and P. J. Caliri p 151–326 refs (See N68-36184 23-30)

11. LONG-ARC ORBITAL ANALYSIS OF GEOS 1 E. M. Gaposchkin and P. D. Hubley p 327–344 refs (See N68-36185 23-30)

N68-36175*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
EVOLUTION AND INTEGRATION OF GEODETIC RESEARCH AT SAO
Charles A. Lundquist *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 1–16 refs (See N68-36174 23-13)

International efforts in satellite geodesy now span a decade. In 1964, the National Geodetic Satellite Program of the United States incorporated many of the continuing geodetic investigations at the Smithsonian Astrophysical Observatory (SAO). This reports give the results at SAO from Geos 1 data and summarizes the SAO contributions to the geodetic satellite program as of the end of 1967. Author

N68-36177*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DYNAMICAL DETERMINATION OF STATION LOCATIONS USING GEOS 1 DATA
E. M. Gaposchkin *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 25–42 refs (See N68-36174 23-13)

The geodetic satellite Geos 1 is used to determine the location of the observing sites for the Goddard Range and Range Rate system, the Navy TRANET Doppler system, and some cooperating optical observatories. Geos 1 orbits are determined, one per month, for the first 10 months of the satellite. The coordinates are determined by the dynamical method and are expressed in the C6 system of SAO. Directions determined from simultaneous observations are used to verify some results. The coordinates determined are suitable for use as an initial set for a more comprehensive global solution using many satellites. Author

N68-36178*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
IMPROVED VALUES FOR COEFFICIENTS OF ZONAL SPHERICAL HARMONICS IN THE GEOPOTENTIAL
Yoshihide Kozai *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 43–56 refs (See N68-36174 23-13)

Coefficients of zonal spherical harmonics up to the 20th order in the expression of the gravitational potential of the earth are derived from precisely reduced Baker–Nunn observations for 10 artificial satellites with inclinations between 28° and 96°. Author

N68-36179*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE EARTH'S GRAVITATIONAL FIELD AS DERIVED FROM A COMBINATION OF SATELLITE DATA WITH GRAVITY ANOMALIES
Walter Koehnlein *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 57–72 refs (See N68-36174 23-13)

The harmonic coefficients of the earth's gravitational field are determined from a joint analysis of satellite gravity data with free-air gravity anomalies. The zonal coefficients are considered up to degree 20, whereas the nonzonal coefficients are fully determined up to 15, 15. The results are shown in geoid and gravity contour maps. Author

N68-36180*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE DETERMINATION OF THE RADIUS OF THE EARTH AND OTHER GEODETIC PARAMETERS AS DERIVED FROM OPTICAL SATELLITE DATA
George Veis *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 76-99 refs (See N68-36174 23-13)

The availability of new geodetic data, together with some laser ranging to satellites and recent determinations of the value of GM, has allowed a new estimate of the semimajor axis of the earth's ellipsoid, based on the results of the 1966 Smithsonian Institution Standard Earth. At the same time, a number of other geometric parameters have been determined, giving a consistent set of parameters that define the geometric and dynamic properties of the earth. Author

N68-36181*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
JUPITER, FLORIDA, INTERCOMPARISON EXPERIMENT
E. Horine, J. Latimer, D. Le Conte, and M. Wolf *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 101-128 refs (See N68-36174 23-13)

The instrumentation and operational procedures used in the photography of Geos 1 flashes with the Baker-Nunn and K-50 geodetic cameras at Jupiter, Florida, in 1966 are described. The six other optical systems participating in the test are summarized. Joint observational data of the Baker-Nunn and K-50 geodetic cameras are analyzed. Author

N68-36306 California Univ., Los Angeles.
ATMOSPHERIC MOTIONS DEDUCED FROM GEOMAGNETIC VARIATIONS ASSOCIATED WITH SOLAR FLARES
Stanley Marshall Greenfield (Ph.D. Thesis) 1967 114 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-244

It is the objective of the present investigation to explore to what extent the detailed time history of SFE Solar Flare Effects current systems can provide information regarding ionospheric winds. The magnetic variations produced by the solar flare (importance 3B) of August 28, 1966 (1522UT), and recorded at 36 magnetic observatories are analyzed in detail. The observed sequence of the SFE current systems for this flare event is interpreted in terms of a time-dependent spectral output from the sun and altitude-dependent wind (and conductivities) in the current-carrying layers of the ionosphere. In order to give quantitative basis to this interpretation, a program is developed for solving numerically the dynamo equation generalized to the case where the ionospheric wind and conductivities are functions of altitude, and geographic latitude and longitude. Typical current systems produced by a simplified solar flare model and various hypothetical combinations of periodic and nonperiodic winds in the ionosphere are illustrated. It is concluded that SFE current systems deduced for the flare imply a global wind pattern that varies appreciably with altitude, in the D and E regions of the ionosphere. Dissert. Abstr.

N68-36402*# Interior Dept., Washington, D. C. Geological Survey.
SELECTED BIBLIOGRAPHY OF REMOTE SENSING
Robert B. Honea, comp. and Virginia L. Prentice, comp. [Sep. 1968] 35 p refs
(NASA Order R-09-020-013)
(NASA-CR-97125; NASA-129) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Publications pertaining to the geographic applications of remote sensing techniques are presented in a four-part bibliography. The first part includes publications that provide an overview of the field and its geographic applications, while more technical publications are listed in the second part. Publishers and prices of the latter list are included. Part III contains documents relating to land use classification and analysis, and Part IV is a selected bibliography of data handling and automatic data processing techniques used in remote sensing. References in each part are listed alphabetically according to author. M.W.R.

N68-36408# California Univ., San Diego. Scripps Inst. of Oceanography.
ATMOSPHERIC OPTICAL MEASUREMENTS IN THE VICINITY OF CRATER LAKE, OREGON, PART 1
Almerian R. Boileau Jul. 1968 22 p refs
(Contract NObs-92058)
(SIO-REF.-68-18, Pt. 1; AD-673298)

This report presents new atmospheric optical data measured by airborne optical and meteorological sensors recorded near Crater Lake, Oregon, during the first day of a three day period in August 1966. Two data gathering descents were made, from 7800 m to 1400 m, and from 8800 m to 2700 m. The times of these descents were 0913 and 0930 and 1045 to 1101, Pacific Daylight Time. Atmospheric beam transmittances were measured also by a ground station located south of Crater Lake at an altitude of 2070 m. Data presented are altitude profiles of heading of aircraft, temperature, relative humidity, equilibrium luminance, horizontal path function, attenuation length, nadir luminances, and downwelling and upwelling illuminances and their ratios. Author (TAB)

N68-36413# Joint Publications Research Service, Washington, D. C.
SURFACE LAYER TURBULENCE AND WIND WAVES
30 Sep. 1968 51 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atm. i Okeana (Moscow), v. 4, no. 6, Jun. 1968 p 647-670, 759-764
(JPRS-46563) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DISSIPATION OF TURBULENT ENERGY IN THE SURFACE LAYER OF THE SEA S. A. Kitaygorodskiy and Yu. Z. Miropol'skiy p 1-20 refs (See N68-36414 23-13)

2. INVESTIGATION OF THE TWO-DIMENSIONAL ENERGY SPECTRUM AND LENGTH OF WIND WAVES Yu. M. Krylov, S. S. Strekalov, and V. F. Tsyplukhin p 21-36 refs (See N68-36415 23-13)

3. WIND WAVES AND EFFECTIVE REFLECTING AREA OF THE SEA SURFACE Yu. A. R. Mullamaa p 37-45 refs (See N68-36416 23-13)

N68-36414# Joint Publications Research Service, Washington, D. C.
DISSIPATION OF TURBULENT ENERGY IN THE SURFACE LAYER OF THE SEA
S. A. Kitaygorodskiy and Yu. Z. Miropol'skiy *In its* Surface Layer Turbulence and Wind Waves 30 Sep. 1968 p 1-20 refs (See N68-36413 23-13)

Estimates of energy dissipation in the upper layer of the sea are presented on the basis of calculations of various mechanisms of energy supply by small-scale sea turbulence as a result of the wind effect. Within the framework of models taking into account the transformation of the energy flux from the wind to the waves into an energy flux to small-scale turbulence through the sea surface, the authors present computations of the vertical distribution of the dissipation of turbulent energy in the upper layer of the sea when a spectrum of wind waves is present at its surface. The results of the computations are compared with available experimental data. Author

N68-36415# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE TWO-DIMENSIONAL ENERGY SPECTRUM AND LENGTH OF WIND WAVES
Yu. M. Krylov, S. S. Strekalov, and V. F. Tsyplukhin *In its* Surface Layer Turbulence and Wind Waves 30 Sep. 1968 p 21–36 refs (See N68-36413 23-13)

Problems involved in the transformation of the lengths of wind waves in a narrow coastal zone with linear isobaths were examined. A linear spectral theory was developed and the changes in the lengths of wind waves in the coastal zone were computed on the basis of a stipulated two-dimensional energy spectrum of rises of the sea surface in deep water. The two-dimensional spectrum used was obtained on the basis of experimental data. A method is proposed for computing the transformation of the lengths of wind waves in a narrow coastal zone, checked on the basis of reliable data from a standard aerial stereographic photographic survey of sea waves under real conditions. This method considerably reduces the mean length of a wave (up to 40%) in comparison with the presently used methods based on study of a regular wave. Author

N68-36416# Joint Publications Research Service, Washington, D. C.
WIND WAVES AND EFFECTIVE REFLECTING AREA OF THE SEA SURFACE
Yu. A. R. Mullamaa *In its* Surface Layer Turbulence and Wind Waves 30 Sep. 1968 p 37–45 refs (See N68-36413 23-13)

A method was developed for computing the mean area of the wave-churned sea surface screened by waves from the light source or from the observer. It was found that it is important to take the casting of shadows into account in the case of zenith distances greater than 70°. Allowance for shadows increases the accuracy in computing the optical properties of the sea surface. Author

N68-36445# California Univ., San Diego. Scripps Inst. of Oceanography.
ATMOSPHERIC OPTICAL MEASUREMENTS IN VICINITY OF CRATER LAKE, OREGON, PART 2 Final Report
Almerian R. Boileau Jul. 1968 28 p refs
(Contract NObsr-95251)
(SIO-REF-68-19; AD-673443)

The report, Part II, presents additional atmospheric optical data, comparable to the data presented in Part 1, but for a different type of day, and for four descents instead of two. Three of the descents were before local apparent noon; the fourth descent was after local apparent noon. Simultaneous spectral irradiance data were recorded at the surface of Crater Lake. Data presented are altitude profiles of heading of aircraft, temperature, relative humidity, equilibrium luminance, horizontal path function, attenuation length, nadir luminance, upwelling and downwelling illuminances and their ratios, reflectance calculated from nadir luminance, atmospheric beam transmittances for vertical path of sight as a function of solar zenith angle, and downwelling illuminance as a function of solar zenith angle. Author (TAB)

N68-36489# Environmental Data Service, Silver Spring, Md.
GUIDE TO SOVIET LITERATURE ACCESSIONS IN THE ATMOSPHERIC SCIENCES LIBRARY AND THE GEOPHYSICAL SCIENCES LIBRARY, JANUARY–FEBRUARY 1968
Feb. 1968 79 p refs
(WB/TA-19; PB-178693) CFSTI: HC$3.00/MF$0.65

A considerable quantity of literature on meteorology and related sciences is being published in the U.S.S.R., and the Atmospheric Sciences Library and the Geophysical Sciences Library succeed in obtaining the majority of the more significant material. However, since most scientists are not well versed in Russian, inadequate use can be made of the literature. This Guide is not prepared to provide complete translations but, rather, to give at least an initial access to the content of the Russian literature. This is done by providing translated tables of contents and annotations together with, on a selective basis, author's abstracts, introductions, summaries, and conclusions. Author (USGRDR)

N68-36520# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
MEASUREMENTS OF THE THERMAL REGIME OF THE SOIL AND ATMOSPHERE NEAR AN ARCTIC TUNDRA SURFACE
John J. Kelley, Jr. and Darrell F. Weaver Aug. 1968 37 p refs
(Contract Nonr-477(24))
(SR-12; AD-673419)

The results of measurements of ambient air temperature and temperature profiles in the tundra soil and snow near Barrow, Alaska, are presented for the period September 1965 to September 1966. Data for the diurnal variation of temperature and net total radiation. Daily depth of thaw during the summer of 1966, and an empirical method of calculating the depth of thaw are given. Author (TAB)

N68-36550# Joint Publications Research Service, Washington, D. C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 188
12 Sep. 1968 77 p refs Transl. into ENGLISH from Russian
(JPRS-46412) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. ASTRONOMY p 1–9 (See N68-36551 23-29)
2. METEOROLOGY p 10–33 refs (See N68-36552 23-20)
3. OCEANOGRAPHY p 34–41 refs (See N68-36553 23-13)
4. TERRESTRIAL GEOPHYSICS p 42–59 refs (See N68-36554 23-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 60–69 refs (See N68-36555 23-13)

N68-36553# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 188 12 Sep. 1968 p 34–41 refs (See N68-36550 23-13)

News releases and Soviet scientific articles in oceanography are abstracted. A petrographic study of rock samples from the Arabian Sea–Indian Ocean ridge revealed a class of spilites. Summarized data are given on geological and geophysical investigations of the ocean floor, which led to the conclusion that in rift zones a special tectonic region exists in which there is an extremely intensive reworking of the earth's crust. Heat fluxes in tectonic structures of the southeast part of the European U.S.S.R. and in the East Pacific and Indian Oceans were measured. One-parameter model of the vertical distribution of density is presented for the study of the thermohaline circulation in an ocean. Magnitude of energy dissipation in upper sea layer is estimated by allowing for sea turbulence induced by the wind. Optical properties of the wave excited sea surface are determined. B.P.

N68-36554# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 188 12 Sep. 1968 p 42–59 refs (See N68-36550 23-13)

Abstracted data are presented on selected Russian scientific articles in the area of terrestrial geophysics. Geological structures are defined for the folded basement of lowland Crimea, for complex folds in platform regions, for folded basements in the Russian European region, and for the Black Sea and Sea of Azov. Boundary conditions for supplementing differential equations to describe electromagnetic fields of rocks are derived. Wave propagation in a thin layered medium is considered. Magnetotelluric studies on Kerguelen Island and on deep layers of the earth are interpreted. Elastic pulses formed during compression destruction of rock samples are grouped. Paleomagnetic studies were made of upper pliocene and quaternary deposits of Kamchatka. Geomagnetic storm makeup, measurement errors in magnetic noise, and magnetic disturbances in the equatorial region were analyzed. Theoretical descriptions are presented for determining depth of the top of a crystalline basement, refracted wave travel time curve, and wave amplitudes in a layered overburden. B.P.

N68-36555# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 188 12 Sep. 1968 p 60-69 refs (See N68-36550 23-13)

Reviews of recent Soviet literature on upper atmosphere and space research are abstracted. Satellite data on plasmas beyond the earth's magnetosphere and radioastronomical observations of circumsolar and interplanetary plasma are summarized. A working model is presented for determining the interaction character between solar wind and earth's magnetic field. Observations on polar cap absorption and on types and degree of cloudiness in Antarctica, and ionospheric soundings over Kiev are noted. The possibility of constructing a total absorption cosmic ray spectrometer is discussed theoretically. Pulsars, lunar investigation, space law, selection of cosmonauts for interplanetary flight, and a book on the dynamics of low thrust spacecraft are also reviewed. B.P.

N68-36556# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
A SYSTEM FOR THE ANALYSIS OF DISSOLVED OXYGEN, NITROGEN AND ARGON IN NATURAL WATERS
W. Gary Williams (M.S. Thesis) Jun. 1968 61 p refs
(AD-673426)

A complete system has been developed for the shipboard analysis of dissolved oxygen, argon and nitrogen. The system includes an in situ sampler, chromatographic analysis for oxygen, argon and nitrogen and three modes of calibration. The system has been tested in the laboratory and at sea. Estimations of the composition of argon, oxygen and nitrogen in dry air and in air-saturated water are reported. Sea trials indicated that thermistor detectors should be used in the chromatograph instead of hot-filament detectors. Author (TAB)

N68-36557# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
RARE EARTH ABUNDANCES IN MANGANESE NODULES
Alan M. Ehrlich (Ph.D. Thesis) Mar. 1968 222 p refs
(Contracts Nonr-1841(74); AT(30-1)-905)
(DSR-78841; AD-673427)

Concentrations of the rare earths have been determined in ten modern manganese nodules from the Atlantic, Pacific, and Indian Oceans, the Baltic Sea, and Lake Charlotte in Nova Scotia. A nodule from a Paleozoic era sea in Montana, a manganese film from a coral found on the Mid-Atlantic Ridge, and samples of the manganese and phosphorite pavements found on the Blake Plateau were also analyzed. The manganese pavement, a mixed manganese-phosphate concretion from the Blake Plateau and one of the Atlantic nodules with its underlying red clay core were segmented and analyzed. Author (TAB)

N68-36604*# Volt Technical Corp., Washington, D. C.
NIGHT SKY AND LOW LATITUDE AURORAE IN A MAGNETIC STORM PERIOD [CIEL NOCTURNE ET AURORES DE BASSE ALTITUDE EN PERIODE D'ORAGE MAGNETIQUE]
G. Weill and J. Christophe-Glaume 17 Oct. 1968 33 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 23, no. 3, Jul.-Sep. 1967
(Contract NAS5-12487)
(NASA-CR-97165; ST-AA-GM-10764) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Airglow measurements from Haute-Provence Observatory (one solar cycle) and from Tamanrasset (IGY) are analyzed by the technique of superimposed epochs in order to detect any systematic variation during magnetic storms with sudden commencement. At middle latitudes the perturbations are characterized by the occurrence of optical auroral events, such as visible white aurorae, photometric red aurorae, stable auroral arcs; these are treated separately, and a list of events is given for 13 consecutive years. Storm effects on night airglow in the middle and low latitudes are weak and characterized as follows: (1) the A group (5577.02 bands and continuum) increases a few percent during the main phase; in addition, the green line shows a positive post-perturbation with a marked intensity increase 35 hours after the SSC; (2) the B group (OH, Na) decreases by about 10% during the main phase; and (3) the red line at 6300 OI behaves differently at the two stations. At Tamanrasset the northern intertropical arc weakens and sometimes disappears during the main phase. At Haute-Provence the red line intensity is somewhat increased during the storm. A recombination in the F-region cannot explain this effect, which indicates that a weak stable auroral arc may be systematically present during the main phase of the magnetic storm. Author

N68-36779# International Atomic Energy Agency, Vienna (Austria).
TRITIUM AND OTHER ENVIRONMENTAL ISOTOPES IN THE HYDROLOGICAL CYCLE. REPORT OF A PANEL
1967 83 p refs
(STI/DOC-10/73)

Tritium and stable isotopes in precipitation, oceanographic applications of cosmic ray and fallout isotopes, meteorological and hydrological applications of tritium and other isotopes, and techniques for the collection and analysis of isotopic samples are discussed. NSA

N68-36834# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
ANNUAL PROGRESS REPORT, 21 SEPTEMBER 1966-25 SEPTEMBER 1967
Edward Anders 25 Sep. 1967 11 p refs
(Contract AT(11-1)-382)
(COO-382-76) CFSTI: HC $3.00/MF $0.65

Progress is reported on research on trace element abundance in chrondrites, ages of meteorites, cosmic dust in the deep sea estimated from the Ir content of sediments, and orbits of meteorites. Papers issued during this reporting period are listed. NSA

N68-36843 Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE 1966, APRIL-JUNE
R. v. d. R. Woolley 1968 15 p *Its* Royal Observatory Bull. No. 138
HMSO: 2s 6d

Time and latitude observations and radio time signals were tabulated for the period between April and June 1966. Greenwich time and latitude were measured at Herstmonceux with the Photographic Zenith Tube (PZT) at $00^h01^m21.^s02$ east longitude and 50°52'18" north mean latitude. The radio time signals and

standard frequency emissions were carried to four decimal places with the decimal point omitted in the tables. Emission times were measured at Herstmonceux and other cooperating stations; and tables give reception times corrected for receiver lag in addition to the actual reception times of radio time signals. M.W.R.

N68-36844 Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE 1966, JULY–SEPTEMBER
R. v. d. R. Woolley 1968 15 p *Its* Royal Observatory Bull. No. 140
HMSO: 2s 6d

Time and latitude observations and radio time signals were tabulated for the period between July and September 1966. Since the beginning of this reporting period, the Greenwich Atomic Time Scale was determined from the summations of the daily rates of quartz crystal clocks calibrated in terms of a long beam cesium atomic frequency standard (designated CsA). A frequency of 100 kHz was derived from the cesium-controlled oscillator connected to the beat counters of the cesium beam atomic standard that had been installed at Herstmonceux in May of 1966. Both reception times of international radio time signals and of standard frequency emissions corrected for receiver lag were tabulated from Herstmonceux and other cooperating stations. M.W.R.

N68-36845 Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE 1966, OCTOBER–DECEMBER
R. v. d. R. Woolley 1968 18 p *Its* Royal Observatory Bull. No. 143
HMSO: 3s

Time and latitude observations and radio time signals were tabulated for the period between October and December 1966. Greenwich atomic time scale was determined from the mean atomic standard CsA (a long beam cesium atomic frequency standard) at Herstmonceux. Both reception times of international radio signals and of standard frequency emissions corrected for receiver lag were tabulated. Results from different time standards used in making measurements during 1965 and 1966 are diagrammed; differences between Herstmonceux and the cooperating stations did not exceed 10 milliseconds throughout 1966. M.W.R.

N68-36916# Institut Royal Météorologique de Belgique, Brussels.
IONOSPHERIC OBSERVATIONS [OBSERVATIONS IONOSPHERIQUES] Monthly Bulletin, Mar. 1968
1968 25 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

Tables of data of ionospheric observations performed at Dourbes (Belgium) in March 1968 are listed giving daily values of critical frequency, maximal usable frequency, minimal frequency permitting reflection, maximum of occultation and virtual height of the ordinary wave in E and F regions. ESRO

N68-37033# Institut Royal Météorologique de Belgique, Brussels.
OZONE OBSERVATIONS [OBSERVATIONS D'OZONE] Quarterly Bulletin No. 3, 1967
1968 47 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

The ozone content has been measured with a Dobson spectrophotometer at Uccle Meteorological Station (Belgium). Results are given for the third trimester 1967. Partial ozone pressure and temperature at standard levels are indicated. ESRO

N68-37063# Institut Royal Météorologique de Belgique, Brussels.
SOLAR RADIATION [RAYONNEMENT SOLAIRE] Annual Report 1967
1968 64 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

The duration of sunshine and the energy received on ground from direct solar radiation as well as from sky radiation were observed in Uccle (Belgium). Data received from these observations made in 1967 are presented in tabular form. ESRO

N68-37064# Institut Royal Météorologique de Belgique, Brussels.
RESULTS OF GEOMAGNETIC OBSERVATIONS [RESULTATS DES OBSERVATIOOS DU CHAMP MAGNETIQUE TERRESTRE] Annual Report 1967
A. de Vuyst 1968 81 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

A survey of the geomagnetic field has been made in 1967 at Dourbes (Belgium). Tables give the values for magnetic variation as well as horizontal and vertical components of the magnetic field intensity. Mean values are computed for each month of the year. ESRO

N68-37072# Weapons Research Establishment, Salisbury (Australia).
TROPOSPHERIC SOUNDING: A PORTABLE ACOUSTIC SOUNDER
A. R. Mahoney Sep. 1967 25 p refs
(WRE-TM-CPD(T)141) CFSTI: HC $3.00/MF $0.65

An equation for the expected signal to noise ratio of an acoustic sounder is derived. The performance of a 50-ft parabola is considered at several frequencies, and the difference in signal to noise ratio for this parabola and for an array of loudspeakers is compared. The array, due to its high power handling capability, is shown to be particularly suitable for a portable acoustic sounder; a nominal operating range of 3000 ft is predicted. Author (ESRO)

N68-37090# Institut Royal Météorologique de Belgique, Brussels.
IONOSPHERIC OBSERVATIONS [OBSERVATIONS IONOSPHERIQUES] Monthly Bulletin, May 1968
May 1968 25 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

The tables of data of ionospheric observations performed at Dourbes (Belgium) during May 1968 giving daily values of critical frequency, maximal usable frequency, minimal frequency permitting reflection, maximum of occultation and virtual height of the ordinary wave in E and F regions are listed. ESRO

N68-37082# Institut Royal Météorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS [OBSERVATIONS GEOPHYSIQUES] Monthly Bulletin, Apr. 1968
Apr. 1968 41 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

Geophysical observations performed at Dourbes in Belgium during April 1968 are listed giving daily data on geomagnetism, air radioactivity, cosmic radiation, atmospheric electricity and seismic activity. ESRO

N68-37120# Hawaii Univ., Honolulu.
HAWAII INSTITUTE OF GEOPHYSICS Annual Report, 1967–1968
Jul. 1968 114 p refs

The various research activities of the institute are discussed, and specific research facilities, facility grants, and specialized auxiliary

services are summarized. Brief accounts of progress in research are given which encompasses work in meteorology, aeronomy, geology, volcanology and petrology, sedimentology, oceanography, physics and chemistry of the earth's crust and mantle, soil genesis, mineralogy, geodesy, and sound transmission in the sea. B.S.D.

N68-37125# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
LOW LEVEL ISENTROPIC TRAJECTORIES AND THE MIDAS COMPUTER PROGRAM FOR THE MONTGOMERY STREAM FUNCTION
R. J. Engelmann and W. E. Davis Apr. 1968 31 p refs
(Contract AT(45-1)-1830)
(BNWL-441) CFSTI: HC $3.00/MF $0.65

The optimum trajectory for releases of materials at low elevations in the atmosphere is constructed with isentropic charts. Isentropic analysis reveals vertical motions of the material and predicts where the material will appear in the air near the ground. An example of such a trajectory that provides a thorough error analysis of isentropic data, and gives the details of a digital analog simulation computer program for obtaining isentropic data is presented. Author (NSA)

N68-37129# European Space Research Inst., Frascati (Italy).
ROLE OF THE UNIVERSAL INSTABILITY IN AURORAL PHENOMENA
N. D'Angelo [1968] 23 p refs Submitted for publication
CFSTI: HC $3.00/MF $0.65

The role of the 'universal' instability in auroral phenomena is discussed. Excitation of the instability in the non-homogeneous magnetospheric plasma at $R_E \approx 6$ may modulate particle precipitation into the ionospheric auroral regions and account for some of the observations on pulsating (optical) auroras and X-ray pulsations. A brief summary of relevant laboratory experiments on 'drift' waves is also given. Author (ESRO)

N68-37133# European Space Research Inst., Frascati (Italy).
OSCILLATIONS OF THE MAGNETOSHEATH
T. S. Green Paris ESRO Sep. 1967 22 p refs
(ESRO-SN-80(ESRIN)) CFSTI: HC $3.00/MF $0.65

Assuming that some of the oscillations of the magnetic field in the magnetosphere might be due to elastic oscillations of the magnetosheath, an attempt has been made to calculate the frequency with which the magnetosheath oscillates when submitted to the fluctuation of the solar wind pressure on the one hand, and to that of the geomagnetic field on the other. Since the steady-state problem has not yet been solved, two simpler approaches have been tried, i.e. the plane geometry model and the cylindrical model. Although both models neglect the effect of the solar wind momentum, the values obtained are in sufficiently close agreement with recent observations to warrant a more sophisticated treatment of the problem. Author (ESRO)

N68-37140# European Space Data Centre, Darmstadt (West Germany).
COMPARISON OF FIVE GEOMAGNETIC FIELD MODELS WITH MEASUREMENTS
K. G. Lenhart Paris ESRO Jan. 1968 19 p refs
(ESRO-SM-69(ESDAC)) CFSTI: HC $3.00/MF $0.65

Five different sets of coefficients for the spherical harmonics expansion of the main geomagnetic field are compared with measurements in northern Scandinavia. The results show that the newer field models can reproduce the measured field much better than the older ones but they also include a larger number of coefficients and thus consume more computation time. Author (ESRO)

N68-37142# European Space Research Lab., Noordwijk (Netherlands).
MEASUREMENT OF TEMPERATURE IN THE UPPER ATMOSPHERE
D. D. Clark Paris ESRO Jan. 1968 33 p refs
(ESRO-SN-84(ESLAB)) CFSTI: HC $3.00/MF $0.65

The decrease in heat exchange processes at high altitudes makes it necessary to use sensors of low thermal inertia. At the same time the sensor must have robustness to withstand launch environment. A suitable solution has been found in using fine tungsten wire. The smallness of the dimensions of the wire made it possible to use free molecular flow theory to derive the kinetic heating corrections and solar radiation corrections. These were backed up by low-density wind tunnel measurements. The accuracy of measurements made with a fine-wire sensor were estimated to be about 1°C by night, and about 3°C over the sea by day under clear skies. Measurements with this sensor have been made up to heights of 65 km. An alternative method based on infrared emission from carbon-dioxide gas in the atmosphere will be described, and implications of the break-down of thermodynamic equilibrium at the higher levels will be discussed. Author (ESRO)

N68-37144# Institut Royal Météorologique de Belgique, Brussels.
IONOSPHERIC OBSERVATIONS [OBSERVATIONS IONOSPHERIQUES] Monthly Bulletin, Jun. 1968
1968 25 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

Tables of data of ionospheric observations performed at Dourbes (Belgium) in June 1968 are listed giving daily values of critical frequency, maximal frequency, minimal frequency permitting reflection, maximum occultation and virtual height of the ordinary wave in E and F regions. ESRO

N68-37219 Danish Meteorological Inst., Charlottelund. Thule Geophysical Observatory.
MAGNETIC RESULTS 1960
1968 40 p
(GR-41)

Geomagnetic measurements taken at the Thule Geophysical Observatory during 1960 were made by sensitive and insensitive magnetographs at 15 mm/hr and quick-run magnetographs at 180 mm/hr. Scale value and reduction formulas are discussed, as are observed and adopted base-line values. Tables give mean hourly values, extreme values, and daily ranges for horizontal intensity (H), declination (D), and vertical intensity (Z) magnetic elements as well as for the K indices. Diurnal variations are also tabulated for the H, D, and Z elements and for inclination and intensity components during quiet and disturbed periods. M.W.R.

N68-37272# National Physical Lab., New Delhi (India). Radio Research Committee.
SOLAR AND GEOPHYSICAL DATA, PART 2
May 1968 10 p
(RRC-A155, Pt. 2; SG-28) CFSTI: HC $3.00/MF $0.65

Solar and geophysical data obtained with vertical incidence sounding techniques are tabulated for April, 1968. These data include predicted and observed sunspot numbers, 2000 Mc/s solar flux, 100 Mc/s solar flux, optical observations of solar flares, solar flare effects, magnetic storms, ionospheric effects of solar flares, and diagrams of SID events. C.T.C.

N68-37275 Physical Research Lab., Ahmedabad (India).
MONTHLY MEDIAN CHARACTERISTICS ON THE IONOSPHERE OVER AHMEDABAD (23° 01' N, 72° 38' E)
S. S. Degaonkar Apr. 1968 13 p
CFSTI: $3.00

In the data presented on the median characteristics of the ionosphere, the tabulations cover hourly and daily observations of the following: F_0F_2, h_pF_2, f_0F_1, $h'F_2$, $h'F$, f_0E, $h'E$, and f_0E_s. M.G.J.

N68-37276 Physical Research Lab., Ahmedabad (India).
MONTHLY MEDIAN CHARACTERISTICS OF THE IONOSPHERE OVER AHMEDABAD (23°01'N, 72°36'E)
S. S. Degaonkar May 1968 13 p
CFSTI: $3.00
For abstract, see N68-37275.

N68-37277 Physical Research Lab., Ahmedabad (India).
MONTHLY MEDIAN CHARACTERISTICS OF THE IONOSPHERE OVER AHMEDABAD (23°01'N, 72°36'E)
S. S. Degaonkar Jun. 1968 11 p
CFSTI: $3.00
For abstract, see N68-37275.

N68-37278 Physical Research Lab., Ahmedabad (India). Ionospheric and Radio Physical Section.
MONTHLY MEDIAN CHARACTERISTIC OF IONOSPHERE OVER THUMBA (8°33'N, 76°56'E)
R. G. Rastogi Aug. 1967 13 p
CFSTI: $3.00
For abstract, see N68-37275.

N68-37290 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL ECHO SOUNDING: DAPANGO (TOGO), 10° 48'N, 0° 4'E [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: DAPANGO (TOGO), 10° 48'N, 0°O]
Jan. 1967 39 p In GERMAN and ENGLISH
CFSTI: $3.00
Tabulated hourly values and median values for the E and F regions are presented as obtained by vertical echo soundings at Dapango, Togo, during January 1967. K.W.

N68-37291# Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL ECHO SOUNDING: FREIBURG, URSI-CODE 131; 48° 03' 18"N, 07° 35' 24"E [IONOSPHAEREN-DATA, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131; 48°03'18"N, 07°35'24" E]
Jul. 1968 44 p In GERMAN and ENGLISH
(Rept.-265-F) CFSTI: HC $3.00/MF $0.65
Tabulated hourly values and median values for the E and F regions are presented as obtained by vertical echo soundings at Freiburg, Germany, during July 1968. K.W.

N68-37292# Ionospharen-Institute Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, AUGUST 1968 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131]
Aug. 1968 44 p In ENGLISH and GERMAN
(Rept.-266-F) CFSTI: HC $3.00/MF $0.65
Tabulated hourly values and median values for the E and F regions are presented as obtained by vertical echo soundings at Freiburg, Germany, during August 1968. K.W.

N68-37346 Port Moresby Geophysical Observatory (New Guinea).
MAGNETIC DATA — Port Moresby, August 1968
D. Denham 11 Sep. 1968 5 p
CFSTI: $3.00
Tabulated data are presented on the magnetic effects from normal magnetograms, pulsations pi and pc, K indices, and monthly storms. Author

N68-37348 Port Moresby Geophysical Observatory (New Guinea).
PRELIMINARY EARTHQUAKE PHASES, 27 AUGUST–1 SEPTEMBER 1968
D. Denham Aug. 1968 4 p
CFSTI: $3.00
Tabulated data are given on preliminary earthquake phases from the stations of Port Moresby, Goroka, Lae, and Konedobu for the period 27 August through 1 September 1968. Author

N68-37349 Port Moresby Geophysical Observatory (New Guinea). Bureau of Mineral Resources.
PRELIMINARY EARTHQUAKE PHASES, SEISMOGRAPH STATIONS, 2–9 SEPTEMBER 1968
D. Denham Sep. 1968 8 p
CFSTI: $3.00
For abstract see N68-37348

N68-37350 Port Moresby Geophysical Observatory (New Guinea). Bureau of Mineral Resources.
PRELIMINARY EARTHQUAKE PHASES, SEISMOGRAPH STATIONS, 9–15 SEP. 1968
D. Denham Sep. 1968 13 p
CFSTI: $3.00
For abstract see N68-37348

N68-37353* Geological Survey, Washington, D. C.
AERIAL INFRARED SURVEYS AT THE GEYSERS GEOTHERMAL STEAM FIELD, CALIFORNIA
R. M. Moxham [1968] 84 p refs
(NASA Order R-09-020-011)
(NASA-CR-97274; NASA-123) CFSTI: $3.00 CSCL 08G
The aerial infrared surveys indicate that the principal high temperature zones at The Geysers are in part limited (at the surface) on the southwest by structural lineaments; their northeast extent tends to be more diffuse. An arcuate radiance pattern suggesting slightly elevated surface temperatures, extends beyond the northwest present limit of steam production at the Sulphur Banks. The arcuate zone seems to coincide with a temperature difference measured on the surface, and with a mapped fault, as well. There are other slightly elevated radiance patterns in Big Sulphur Creek valley, but their significance is not known. The radiance in Big Sulphur Creek valley, except for the hydrothermal alteration zones, is not exceptional, that is, there is little evidence of a regional geothermal anomaly at the surface in The Geysers area. Author

N68-37354# National Physical Lab., New Delhi (India). Radio Research Committee.
IONOSPHERIC PREDICTIONS FOR APRIL 1968
Dec. 1967 4 p
(RRC-B139) CFSTI: HC $3.00/MF $0.65
Graphs of predicted median foF_2 values and predicted median $MUF(4000)F_2$ values are presented, along with a nomogram for transforming F_2-zero-MUF and F_2-4000-MUF to equivalent maximum usable frequencies at intermediate transmission distances. Author

N68-37355# National Physical Lab., New Delhi (India). Radio Research Committee.
IONOSPHERIC PREDICTIONS FOR MAY 1968

Dec. 1967 4 p
(RRC-B140) CFSTI: HC $3.00/MF $0.65
For abstract see N68-37354

N68-37361 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, ABSORPTION MEASUREMENTS: FREIBURG, URSI-CODE 131; 48° 03' 18" N, 07° 35' 24" E, JANUARY–JUNE 1968 [IONOSPHAEREN-DATEN, ABSORPTIONS-MESSUNGEN: FREIBURG, URSI-CODE 131; 48° 03' 18" N, 07° 35' 24" E, JANUAR–JUNI 1968]
Jun. 1968 14 p refs In GERMAN
CFSTI: $3.00

Ionospheric echo absorption measurements over Freiburg, Germany, for the period January through June 1968 are reported. Tables contain automatic registration data for amplitudes of eight different frequencies. Transl. by G.G.

N68-37383# India. Meteorological Dept., New Delhi.
THREE HOURLY INDICES OF GEOMAGNETIC ACTIVITY
[1967] 2 p
CFSTI: HC $3.00/MF $0.65

Based on data from the Magnetic Observatory at Alibag, India, tabulations are presented for the months of October 1967, November 1967, December 1967, January 1968, February 1968, and March 1968. M.G.J.

N68-37390*# California Univ., Berkeley. Space Sciences Lab.
ASYMMETRY IN GEOMAGNETIC RESPONSE TO THE POLARITY OF THE INTERPLANETARY MAGNETIC FIELD
John M. Wilcox 15 Jul. 1968 7 p refs Submitted for publication *Its* Ser. No. 9, Issue No. 33
(Grants NsG-243; NGR-05-003-230; Contract Nonr-3656(26); Grant NSF GA-1319)
(NASA-CR-97262; AD-673256) CFSTI: HC $3.00/MF $0.65 CSCL 08N

The difference between northern and southern hemispheric geomagnetic activity is investigated as a function of the sector polarity pattern of the interplanetary magnetic field. It is found for the year 1964 that sectors with field directed away from the sun are associated with slightly enhanced northern hemisphere activity, and toward sectors are associated with slightly enhanced southern hemisphere activity. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-36014 European Organization for Nuclear Research, Geneva (Switzerland).
A BEAM-PROFILE ANALYSER USING PROPORTIONAL MULTIWIRE CHAMBER
G. Amato and G. Petrucci 6 Aug. 1968 14 p refs
(CERN-68-33)

Proportional multiwire chambers were used as particle detectors in a beam-profile analyzing apparatus designed to speed up the tuning procedure for high energy secondary beams. The apparatus consists of a separate chamber for both the horizontal and vertical planes, wire pulse amplifiers, a channel analyzer, a channel scanning system, and an oscilloscope. With each machine pulse, profiles of the secondary beams in each plane appear on the scope; and, by associating this output with fast signals from a Cerenkov or scintillation counter, it is possible to obtain beam profiles for a particular type of particle. The chambers do not have any appreciable effect on the beams even at the lowest energy momentum levels. M.W.R.

N68-36021*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A SMALL COMBINATION SENSING PROBE FOR MEASUREMENT OF TEMPERATUE, PRESSURE, AND FLOW DIRECTION
George E. Glawe, Lloyd N. Krause, and Thomas J. Dudzinski Washington Oct. 1968 20 p refs
(NASA-TN-D-4816) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design features and characteristics of a small combination sensing probe for the measurement of total temperature, total pressure, and flow direction of a gas stream are presented. Also, with proper consideration, a flow direction sensing hold hole indication can be used to determine static pressure. Experimental data are presented for the aerodynamic recovery and time response of the temperature sensor, the flow angle characteristics of the total pressure sensor, and the sensitivity of the flow direction wedge. These data were obtained over a subsonic Mach number range of $0.2 \leq M < 1$, as well as at $M = 1.4$. Author

N68-36027# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
MODIFICATION OF AN ELEMENTARY GAS CHROMATOGRAPH FOR AEROSPACE GAS ANALYSIS REQUIREMENTS
N. Kameno Aug. 1968 17 p refs
(FSN-AD9-01-681)

An inexpensive commercially available gas chromatograph, designed as an educational demonstration unit, was modified for use in gas analysis and production control applications. The modification permits the equipment to be used for trace analysis of fixed gases to the ppm (parts per million) level and below by using a cryogenic trapping technique. Quantitative analysis of gas mixtures also can be performed, with a relative error of ±5 percent. Author

N68-36143#
COSMIC RAY PATROL RECORDER
Iu. G. Shafer and A. V. Iarygin 23 Nov. 1965 6 p Transl. into ENGLISH from Geomag. i Aeronom. (Moscow), v. 8, no. 4, 1968 p 765–769
CFSTI: HC $3.00/MF $0.65

An instrument is described for use on artificial satellites. This cosmic ray patrol recorder is intended to measure the space and time distributions of cosmic ray intensity in the energy range subjected to the influence of the earth's magnetic field. A peculiarity of the instrument is the possibility of using it to measure the radiation intensity at many points of the near-earth orbit without utilizing external storage. The range of measurement of the radiation intensity is 0.25 to 250 particles/cm^2/sec. One radio channel in the direct transmission mode for not less than a 2-minute communication session is required to transmit all the information. The circuit diagram of the instrument is presented, along with a graph of the operation of its components. The instrument consists of a counting rate meter, programmer, storage, and output. Information on the cosmic ray intensity are discrete values of the particle counting rate at five orbit points. Author

N68-36303 Missouri Univ., Columbia.
AN ANALYSIS OF THE FLUX-GATE MAGNETOMETER
Stanley Vernon Marshall (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-317

The measurement of magnetic fields using fluxgate techniques dates back to the 1930's, but the use of airborne units of high sensitivity for geophysical surveys and submarine detection began in the early 1940's. Since then, various forms of the fluxgate probe have undergone only slight changes and few variations in design have been introduced. The units in use today are very similar in principle to the early models. However, the physical form and composition of the core material have been receiving more attention in recent years as the fluxgate magnetometer is used more and more in exploration of the magnetic field of the earth and that of outer space. In spite of its widespread use for the past twenty-five or more years, there has not been found in the literature a model for the fluxgate probe with which one might determine the necessary steps to improve its sensitivity (volts/oersted). The investigation has been directed toward this purpose, using the ring-core form of probe. Dissert. Abstr.

N68-36393# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
MODELS FOR ANALYSIS OF THE CAPABILITIES OF GROUND BASED SENSORS IN DETERMINING THE MASS OF ORBITING BODIES– EXTENDED MODELS, VOLUME 2
Walter J. Culver, Donald S. Doeg, Williard L. Marquart, and R. Gary Aug. 1967 68 p refs
(Contract F19628-67-C-0041)
(ESD-TR-68-157, v. 2, TR-3; AD-673514)

The report contains a description of the models to be used in analyzing the capabilities of ground-based sensors in determining the mass of orbiting bodies, model coefficients, and the justification for their selection. Relations are derived for computing sensitivity coefficients and their coupling to mass variance for the case of noisy, biased sensors (monostatic and tri-static radars, Baker - Nunn cameras), and for spherical and tumbling cylindrical satellites. Author, (TAB)

N68-36399# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
IMAGE ENHANCING MICROSCOPE Final Technical Report, 1–31 May 1968
Griffiss AFB, N. Y. RADC Aug. 1968 57 p refs
(Contract AF 30(602)-4397)
(U-4398; RADC-TR-68-247; AD-673481)

The report describes the considerations which were used in the design of the Image Enhancing Microscope. Derivation of the theoretical factors affecting system signal-to-noise ratio and resolution are given. Reasons and experimental background are detailed to justify the selection made for each of the critical system components. Descriptions are given of aperture correction and phosphor compensation circuitry which extract the maximum performance from critical components with less than theoretically ideal performance. Representative imagery is included which illustrates high resolution, contrast enhancement, outlining and crispening. Author (TAB)

N68-36434# Sheffield Univ. (England). Dept. of Mining.
RECORDING AND MONITORING SYSTEMS FOR PHOTOELASTIC TRANSDUCERS Final Report, May 1967–Jun. 1968
A. Roberts Jul. 1968 36 p refs
(Contract DAJA37-67-C-0585)
(AD-673848)

A report on an investigation of problems of recording and monitoring the optical signals displayed by photoelastic transducers under constraint. The methods considered include photocell systems, solid circuit photocell mozaics, and a photographic system. Author (TAB)

N68-36466# Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Laboratorio di Elettronica.
HELIUM-3 NEUTRON COUNTER TUBES
R. Cervellati, A. Kazimierski, and P. Monaci *In its* Activity Coord. in the Field of Electron. and Instr., Pt. 3 1967 p 77-96 refs (See N68-36462 23-28)

The detection of thermal neutrons by the reaction n + ^{3}He → p + ^{3}H + 746 keV has increasingly found applications since the ^{3}He gas is being sold at a low price. ^{3}He is used in ionization chambers, proportional counters of standard design, and in several less usual devices e.g. as a neutron sensitive element between two semiconductor detectors. The cross section of ^{3}He for thermal neutron absorption is 5040 barn; therefore this nuclide is preferred to ^{10}B when the measurement of low neutron fluxes is required. Besides, when used in proportional counters, ^{3}He is preferred to boron trifluoride also because of the higher purity of the filling obtainable with it; this makes it possible to use pressures of several atmospheres thus obtaining an efficiency close to 1 with an active length of few centimeters. Author

N68-36506# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
DEVELOPMENT OF A PRESSURE TRANSDUCER WITH A SHORT RESPONSE TIME BASED ON STRAIN WIRES FOR MEASUREMENTS AT LOW PRESSURES [ENTWICKLUNG EINES DRUCKGEBERS KURZER ANSPRECHZEIT AUF DER BASIS VON DEHNMESSDRAEHTEN FUER MESSUNGEN BEI GERINGEN DRUEKEN]
H. P. Kabelitz, P. J. Weber, and W. Wyborny Aug. 1968 30 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-53; DVL-778) CFSTI: HC $3.00/MF $0.65

The development, construction, and functioning of a pressure transducer design with strain wires is described. The strain wires are imbedded in an elastic, insulating base. The gage is especially suited for measurements in shock tunnels because it has a very short rise time (< 1 μsec), very high sensitivity, and high overload capacity. The application of the gage was demonstrated by measurements in a gun tunnel. K.W.

N68-36517# General Precision, Inc., Pleasantville, N. Y. GPL Div.
WIDE ANGLE TELEVISION PROJECTION, PHASE 3. VOLUME 1: BASIC AND APPENDICES A, B, AND C Final Engineering Report
Estelle Rosen, Clayton A. Washburn, and Urban H. Santone Orlando, Fla. Naval Training Device Center Feb. 1968 98 p refs
(Contract N61339-695)
(NAVTRADEVCEN-695-2, v. 1; AD-673444)

The objective of this phase was to design, construct and install the wide angle TV projector. The camera and wide angle lens were developed under Phases I and II, and detailed in Navtradevcen 695-1. This three segment projector complements the three channel pickup camera, and displays the televised image on a ten foot radius hemispherical screen segment. The angle is 53 degrees in height and 160 degrees in width. It is intended that the entire system will be utilized as a laboratory research tool in connection with training devices that require a visual display for which this television system would be considered appropriate. Author (TAB)

N68-36530*# Utah Univ., Salt Lake City.
ENTRY LENGTH FOR THE ROCKET METEOROLOGICAL RADIATION SHIELD

Forrest L. Staffanson, Sadiq Alsaji, and Ronald Fazzio. Washington NASA Oct. 1968 27 p refs
(Grant NGR-45-003-025)
(NASA-CR-1200) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A derivation is presented for the thermal entry length which determines the depth within a tubular radiation shield that a temperature sensor may be placed without incurring convective heat transfer between the shield and sensor. Data are presented as a function of shield diameter, altitude, and sensor viewing angle. It is concluded that radiation shields of the diameter of the 4-inch meteorological rocket will provide significant shielding to 80 km altitude and shields of the diameter of the 1-inch dart to 60 km. Author

N68-36531# General Precision, Inc., Pleasantville, N. Y. GPL Div.
WIDE ANGLE TELEVISION PROJECTION, PHASE 3. VOLUME 2: APPENDICES D, E, F, G, AND H Final Engineering Report
Estelle Rosen, Clayton A. Washburn, and Urban H. Santone Orlando, Fla. Naval Training Device Center Feb. 1968 76 p refs
(Contract N61339-695)
(NAVTRADEVCEN-695-2, v. 2; AD-673445)

This volume contains schematic diagrams, mechanical drawings, and specifications relating to the wide angle television system. TAB

N68-36565*# Technical Operations, Inc., Arlington, Va.
A PROTOTYPE SELECTION SYSTEM FOR THE OPTIMAL CHOICE OF AN INSTRUMENT PACKAGE
Robert M. Barnes, Joseph Diestel, and Stanley B. Rosen Sep. 1967 41 p refs
(Contract NAS12-515)
(NASA-CR-86100) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Details are given on a prototype selection aid which was contrived to demonstrate the potential applicability and value of such a system as an aid to project and program planning. It is also delineated as a systematic, quantitative approach for use in selecting instrument packages to be flown aboard space vehicles, and as a flexible aid which would allow alternative selection structures. A detailed analysis of the present selection process is presented along with a quantitative formulation of the selection process and some suggested benefit calculation and optimization techniques. The selection aid, which utilizes a set of computer programs, sequences and formulates a quantifying system for selection. The general mathematical representation of the instrument selection process is discussed, and the useful application of this formulation is shown. B.S.D.

N68-36602# California Univ., Livermore. Lawrence Radiation Lab.
SENSITIVITY OF PHOTO ELECTRIC DIODE DETECTOR FOR SOFT FLUORESCENT X RAYS
J. L. Gaines and G. R. Leipelt 27 Apr. 1968 6 p
(Contract W-7405-ENG-48)
(UCID-15248) CFSTI: HC $3.00/MF $0.65

The experimental arrangement for determining the sensitivity of a photoelectric diode to soft fluorescent X rays is described. A sodium iodide scintillation detector is utilized. NSA

N68-36623*# TRW Systems, Redondo Beach, Calif.
RESEARCH PROGRAM ON HOLOGRAPHIC INSTRUMENTATION Final Report
L. O. Heflinger and R. E. Brooks 15 Jun. 1968 92 p refs
(Contract NASw-1572)
(NASA-CR-73266; TRW-07821-6004-R0-00) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This report describes investigations conducted to improve instrumentation techniques by the application of holography. Methods for producing holograms suited to particle impact studies and several holographic interferometer systems are described. Some interferometer techniques useful in obtaining increased sensitivity are analyzed and experimentally tested. Author

N68-36646# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPARING THE DISPERSITY OF A LATENT IMAGE FORMED BY THE ACTION OF LIGHT AND ACTION OF IONIZING PARTICLE [SRAVNENIE DISPERSNOSTI SKRYTOGO IZOBRAZHENIYA, OBRAZOVANNOGO DEISTVIEM SVETA I DEISTVIEM IONIZUYSHCHIKH CHASTITS]
A. L. Kartuzhanskii Oct. 1967 13 p Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 9, no. 4, 1964 p 276-282
(FTD-HT-23-483-67; AD-673756)

Sensitograms (A-D), prepd. by exposing Panchrome-10 neg. film to light for 60 sec. (A), light for 10 microsec. (B), the action of strongly ionizing alpha-particles from 210Po (C), and the action of weakly ionizing beta-particles from 32P (D), were treated in an identical manner. The kinetics of development, of regression and the Herschel effect were pratically the same for (C) as for (B). The development time decreased in the order (A) > (B), (C) > (D), and the rate of regression was in the order (D) > (C) > or = (B) > (A). Sensitization with triethanolamine was in the relative order (A) > (B), (C) > (D). On desensitization with 0.05% chromic acid, the loss in sensitivity was 0.95, 1.36, 1.30, and >1.6 for (A), (B), (C), and (D), resp. The photometric equiv., which constitutes a measure of the dispersity of the latent image, was 2.6, 3.0, 2.9, and 3.4, resp. The results obtained demonstrated the high dispersity of latent images produced by ionizing particles vs. that produced by light; the light image with the highest dispersity (B) corresponds to the particle image with the lowest dispersity (C). It follows from this that photographic characteristics which depend on continuous changes in dispersity of the latent image do not overlap for the two types of radiation. Author (TAB)

N68-36663# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.
FAST NEUTRON TIME OF FLIGHT SPECTROMETER
Muhammad Yasin Malik, Tariq Jamal Solaija, and Abdul Ghani Jun. 1967 18 p refs
(PINSTECH/PHY-6)

A time of flight spectrometer to be used for the measurement of prompt fission neutron energy spectrum is described. The time resolution of the system has been determined using the coincidence cascade gamma radiations from a ^{60}Co source. A review of the problems associated with the photomultiplier timing is given. The limitations on time resolution of the present set-up are discussed and ways of further improvements are suggested. A time resolution of 3.3 nanosec has been achieved. Author (NSA)

N68-36715# Sandia Corp., Albuquerque, N. Mex.
DOWNHOLE COMPASS SYSTEM
Bruce Noel Oct. 1967 24 p
(Contract AT(29-1)-789)
(SC-DR-67-754) CFSTI: HC $3.00/MF $0.65

The theory, operational procedure, and calibration procedure for a downhole compass system are discussed. The system is used to determine the azimuthal orientation of an instrument canister in a deep hole. Author (NSA)

N68-36716# Atomic Energy Commission Research Establishment, Riso (Denmark).
BURN-OUT METER

P. Z. Skanborg Oct. 1967 7 p In DANISH
(RISO-M-643; R-22-67)

The so-called burn-out meter gives information about the cooling conditions at the place where the detector is placed. It is intended to be used in reactors to protect the fuel elements. The detector has to be placed at the outlet end of the fuel element. It consists of an electrically heated Pt-wire. Author (NSA)

N68-36724# Virginia Univ., Charlottesville. Leander McCormick Observatory.
THE VIRGINIA DUAL-CHANNEL PHOTOELECTRIC PHOTOMETER
H. John Wood and G. W. Lockwood 1967 12 p refs *Its* Publ., Vol. 15, Pt. 5

A description of the dual-channel photometer, digital data recording system and computer reduction procedures is given. Some examples of stellar photometric observations are shown. Author

N68-36738*# Arizona Univ., Tucson. Field Emission and Space Systems Lab.
A MULTIPOINT FIELD IONIZATION SOURCE Final Report, 11 Nov. 1966–12 Apr. 1968
Stuart A. Hoenig and William Farwell 12 Apr. 1968 28 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951560)
(NASA-CR-97221) CFSTI: HC$3.00/MF$0.65 CSCL 20F

An investigation has been made of the use of field ionization and field emitted electrons as ion sources for use with a quadrupole mass spectrometer. It has been possible to replace the normal filament type electron source with a field emission electron source in the form of a 100-point comb. Results with this source have been very satisfactory. The electrons generate a normal bombardment ion spectrum. Operation of this comb as a direct field ion source showed that such source cannot be used for direct injection into a quadrupole type mass spectrometer. The requirements for low energy ions and a straight-through geometry are too severe. It is planned to install an energy analyzer to swing the ion beam about 100° in order to obtain better control and focusing of the ions as they enter the spectrometer and to aid in removal of the high energy electrons and neutrals which introduce high noise levels. Author

N68-36772*# Southwest Center for Advanced Studies, Dallas, Tex. Atmospheric and Space Sciences Div.
A FEASIBILITY STUDY ON THE USE OF A COINCIDENCE MASS SPECTROMETER TO DETERMINE LUNAR ATMOSPHERE CONSTITUENTS Final Report
F. S. Johnson 31 Jan. 1967 38 p
(Contract NAS9-4830)
(NASA-CR-92330) CFSTI: HC$3.00/MF$0.65 CSCL 20F

Experimental evaluation indicates some merit for a Coincidence Mass Spectrometer (CMS) for determining lunar atmosphere constituents. Overall potential of the CMS is limited by noise introduced by stray electrons from the electron beam as well as limited sensitivity because of the requirement that no more than one ion be in flight in the drift tube at any one time. Logic functions and gates, mass discrimination capability, and time resolution requirements of the instrument are discussed. While performance of the CMS was considered somewhat better than for a quadrupole, many component failures were noted. Ion gate functioning was found to be only partially effective. Appendixes deal with the lunar atmosphere and the electrical operation of the CMS, its controls, and internal and interface connectors. The CMS discriminates against noise pulses by requiring that both the ion and the electron released in an ionization event be detected. M.W.R.

N68-36826# Institutt for Atomenergi, Kjeller (Norway). Laser Research Establishment.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF IMPEDANCE VOID METERS
Hans Otto Olsen Aug. 1967 159 p refs Prepared in cooperation with Oslo Univ.
(KR-118) CFSTI: HC$3.00/MF$0.65

A survey of literature on theories on the dielectric constant, especially the electric conductivity of two phase media, is given. Impedance void meters of different types and number of electrodes are calibrated against a quick closing valves system in an air–water loop channel diameter 26 mm. The influence of several parameters on the void meter readings is investigated. The experimental results show dependency of flow rate, electrode geometry and flow regime. From experiments and theoretical considerations two alternative void meter geometries are described. Author (NSA)

N68-36933# Lincoln Lab., Mass. Inst. of Tech., Lexington.
IMPROVED FERRIMAGNETIC SINGLE-CRYSTAL SPHERE ORIENTER
Gerald F. Dionne, Phillip S. Crocker, and James F. Smith Jul. 1968 26 p refs
(Contract AF 19(628)-5167); ARPA Order 498)
(TN-1968-16; AD-673355)

A new ferrimagnetic single-crystal sphere orientation device has been developed for use with a variety of sphere sizes and compositions. Similar to other instruments which operate on a magnetic principle, this orienter provides (110) axes alignments. However, with one small electromagnet, it is considerably simpler than previously reported instruments of this type. From theoretical considerations, it is concluded that high alignment sensitivity will be obtained for polished spheres of low mass density, small radius, high magnetocrystalline anisotropy, and low coefficient of friction between sphere and support. It is also concluded that the sphere should be supported in cavities of conical geometry, with the cone angle as small as possible. The results of both X-ray analysis and microscope visual observation with a number of typical spheres indicate that the combination of accuracy and reliability of the instrument is superior to that of the other devices and suggests that the factors controlling the alignment sensitivity as derived from theory are at least qualitatively correct. Author (TAB)

N68-36964# California Univ., Berkeley. Lawrence Radiation Lab.
DELAY-LINE MULTIPLEXING METHOD FOR STORAGE AND DISPLAY OF INFORMATION FROM MAGNETOSTRICTIVE SPARK CHAMBERS
Rory L. Van Tuyl, Victor Perez-Mendez, Kai Lee, and Ronald L. Grove 21 Sep. 1967 10 p refs Presented at the IEEE 14th Nucl. Sci. Symp., Los Angeles, 31 Oct.–2 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17623; CONF-671026-12) CFSTI: HC$3.00/MF$0.65

A system is described that can decrease the number of scalers required in a magnetostrictive spark-chamber readout system by a factor of four. Information from magnetostrictive sensors is impressed upon six magnetostrictive delay lines and digitized in sequence by six sets of scalers. In addition, an oscilloscope display is produced which correlates the delayed time-domain information with its digitized form. Author (NSA)

N68-36977# Technische Hochschule Munchen (West Germany).
DEPENDENCE OF THE MODULATION TRANSFER FUNCTIONS OF PHOTOGRAPHIC FILMS FROM THEIR OPTICAL QUALITIES AND THE STRUCTURE OF THE EMULSION LAYERS [DIE ABHAENGIGKEIT DER MODULATIONSUEBERTRAGUNGSFUNKTION PHOTOGRAPHISCHER FILME VON IHREN OPTISCHEN EIGENSCHAFTEN UND DEM AUFBAU DER EMULSIONSSCHICHT]

Heinz Kramer (Ph.D. Thesis) 1968 101 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

The interrelation between transfer properties and structure, chemical properties, and physical characteristics of the photographic emulsion layer were examined in order to improve the modulation transfer function. Parameters were established for the structure and the optical characteristics of the layer, and the modulation transfer function was derived based on the transfer theory. Instruments for measuring the modulation transfer function are described, among them the Lloyd mirror interference equipment and microphotometers. Packing density and thickness of three emulsions were varied to produce 27 films for measuring layer parameters.
Transl. by K.W.

N68-36983# Technische Hochschule Hannover (West Germany).
A PHOTOELECTRIC STANDARD PYROMETER WITH QUASICONSTANT RECEIVER SENSITIVITY AND GATE WEAKENING IN THE TEMPERATURE RANGE FROM 650°C TO 3700°C [UEBER EIN PHOTOELEKTRISCHES NORMALPYROMETER MIT QUASIKONSTANTER EMPFAENGEREMPFINDLICHKEIT UND SEKTORSCHWAECHUNG FUER DEN BEREICH 650 BIS 3700°C]
Herbert Kunz (Ph.D. Thesis) 1967 131 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Described is the calibration and spectral sensitivity of a photoelectric pyrometer for temperature measurements between 1336°K and 4000°K. The instrument uses a rotating sector disk to chop the light beam and a weak steady light source for comparison with intermitted light emission. Measured correlations between precision sector angles and corresponding photon flux densities show that the instability factor of this proportional correlation method results in only minimal temperature measurement errors.
Transl. by G.G.

N68-37007# Royal Aircraft Establishment, Farnborough (England).
THE RESPONSE OF A NARROW BORE PRESSURE MEASURING SYSTEM TO STEP AND OSCILLATORY PRESSURES
T. W. Chubb Jan. 1968 60 p refs
(RAE-TR-68010) CFSTI: HC $3.00/MF $0.65

Both laminar and turbulent flow theories are presented for systems consisting of smooth narrow bore tubing with various terminating volumes. Experimental results show reasonable agreement with theory for step inputs and good agreement in the oscillatory cases. The response of a pressure scanning valve to a pressure step was investigated and the results indicate that turbulent flow occurs even at very low Reynolds numbers (100); this is due to the complex pneumatic path in the scanning valve.
Author (ESRO)

N68-37036# European Space Technology Center, Noordwijk (Netherlands).
THE MEASUREMENT OF SOLAR ABSORPTANCE AND THERMAL EMITTANCE
M. Westcott Paris ESRO Jan. 1968 47 p refs
(ESRO-TN-23(ESTEC)) CFSTI: HC $3.00/MF $0.65

A brief description is given of instrumentation for the measurement of the thermo-optical properties of surfaces. Particular attention is devoted to an instrument for the calorimetric determination of the ratio of solar absorptance to thermal emittance. The thermal emittances of some surfaces proposed for the ESRO I satellite are presented, and are compared with published values where available.
Author (ESRO)

N68-37037# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
CALORIMETRIC MEASUREMENTS OF STRONG γ-EMITTING SOURCES [MESURES CALORIMETRIQUES DE FORTES SOURCES D'EMETTEURS GAMMA]
Bernard Brangier, Christiane Herczeg, and Robert Henry May 1968 21 p In FRENCH; ENGLISH summary
(CEA-R-3502) CFSTI: HC $3.00/MF $0.65

This publication gives the principle and a description of an adiabatic calorimeter for measuring the real activity of strong γ-emitting sources by absorbing the emitted energy in a mass of copper. Because of the difficulty of evaluating the amount of self-absorption, a calorimeter was built for measuring the self-absorption, and a description of it is given. The results of these three measurements are fairly satisfactory. The calibration and the actual measurements obtained are given with a few corrections made necessary by the design of the apparatus. The correlation of the various results is discussed.
Author (ESRO)

N68-37040# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DESCRIPTION OF METHODS FOR MAKING ACTIVATION DETECTORS FOR USE IN NUCLEAR REACTORS [DESCRIPTION DES PROCEDES DE FABRICATION DES DETECTEURS D'ACTIVATION UTILISES DANS LES REACTEURS NUCLEAIRES]
René Barbalat, Roland Le Coguie, Pierre Leger, Lucien Salon, and Michel Thierry Jul. 1968 81 p refs In FRENCH; ENGLISH summary
(CEA-R-3532) CFSTI: HC $3.00/MF $0.65

Methods currently used for making activation detectors, thin films and various deposits used in nuclear reactors are briefly described. The thicknesses required vary from about a few tenths of a micron to a few tenths of a millimeter. Different techniques are used for fixing the large variety of elements: rolling, moulding, painting, electrolysis, vacuum deposition, thin films, wires, enamels, protective linings, etc.
Author (ESRO)

N68-37134# Commissariat à l'Energie Atomique, Saclay (France). Centre D'Etudes Nucléaires.
STUDY OF A HIGH SURFACE GAS TRIODE FOR DETECTING ATOMIC OR NUCLEAR PARTICLES [ETUDE D'UNE TRIODE A GAZ A GRANDE SURFACE DETECTRICE DE PARTICULES ATOMIQUES OU NUCLEAIRES]
Alain Jacques Lansiart (Ph.D. Thesis--Paris Univ.) May 1968 75 p refs In FRENCH; ENGLISH summary
(CEA-R-3319) CFSTI: HC $3.00/MF $0.65

A triode filled with xenon at atmospheric pressure can be used as an X-ray detector since it produces an appreciable amount of light per quantum absorbed. Various methods are described for studying and reducing the deadtime after the passage of a spark. This detector can be used in medicine for the detection of tumours and also for the rapid recording of diffraction diagrams.
Author (ESRO)

N68-37160# Battelle-Northwest Richland, Wash. Pacific Northwest Lab.
FFTF COOLANT THERMOCOUPLE DEVELOPMENT
C. E. Huck 14 May 1968 15 p refs Presented at ERA/ISA Symp., Seattle
(Contract AT(45-1)-1830)
(BNWL-SA-1857; CONF-680526-1) CFSTI: HC $3.00/MF $0.65

A group of twenty-four thermocouples was exposed to a fast neutron fluence of approximately 2.7×10^{21} as part of a program to develop sodium coolant thermocouples for the Fast Flux Test Facility (FFTF). Chromel/Alumel is the most promising candidate thermocouple based on a negligible amount of decalibration and other thermal neutron reactor effects on this type

of thermocouple. Chromel/Alumel, Geminol-P/Geminol-N, platinum/10% rhodium-platinum, tungsten/26% rhenium-tungsten, and 5% rhenium-tungsten/26% rhenium-tungsten thermocouples were subjected to a series of laboratory materials verification tests, response time tests, and emf calibration runs. The tests are being repeated after EBR-II fast neutron reactor irradiation to determine the extent of transmutation, or other property changes which would affect their performance in the FFTF. Although these initial thermocouple irradiations were run primarily for the purpose of developing measurement and handling techniques, much useful information is being obtained, which is being used in irradiation testing of additional base metal thermocouples. Author (NSA)

N68-37173# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ULTRAHIGH VACUUM REFLECTOMETER FOR USE WITH EXTREME ULTRAVIOLET SYNCHROTRON RADIATION

B. Feuerbacher, R. P. Godwin, and M. Skibowski May 1968 21 p refs

(DESY-68/26)

An ultrahigh vacuum reflectometer is described. It may be used for studies of reflectance, transmittance, and photoemission on samples evaporated in situ. The angle of incidence can be varied from 0 to ±90° in steps of 7.5° for sample and detector independently. The whole system can be rotated about the axis of the incident light for study of polarization effects. With the highly polarized continuum of synchrotron radiation as a light source and a normal incidence monochromator the reflectometer allows measurements in the extreme ultraviolet for wavelengths down to 300 Å for s and p polarized light. Author (NSA)

N68-37183# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

MEASUREMENT OF THE LIMIT OF SENSITIVITY OF HYDROGEN IN A BUBBLE CHAMBER AND CALIBRATION OF PRESSURE GAUGES

G. Horlitz, S. Wolff, and G. Harigel (CERN) Jun. 1968 15 p refs

(DESY-68/30)

A new method of calibrating pressure gages in bubble chambers under operating conditions is described. Starting with different static pressures p_s greater than the vapor pressure p_v, the dynamic pressure in a bubble chamber is reduced to an arbitrary, fixed value p(b,T). At a given temperature T, the appearance of this pressure p(b,T) is indicated by a constant bubble density b. A plot of the signal U of a pressure transducer (corresponding to the pressure drop p_s-p(b,T)) against the static pressure p_s gives a straight line for every single b=const. The slope of these lines is equal to the sensitivity of the gauge. The extrapolated experimental line intersects the axis U=0 in the point p_s=p(b,T), which is independent of the calibration factor of the transducer. In an 85 cm bubble chamber, p(b,T) has been measured in the temperature interval 24.5<T<28.0°K with b=0, which represents the limit of sensitivity in a p-T diagram for relativistic electrons. Author (NSA)

N68-37200# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.

EXPERIMENT: BALLOON-BORNE CAMERAS [EXPERIENCE CAMERAS NOCTURNES BALLON]

[1968] 19 p In FRENCH

CFSTI: HC$3.00/MF$0.65

Two wide angle cameras were designed to obtain far and near ultraviolet pictures of the night sky. A general description of the cameras and their characteristics is presented. Launch windows for a winter season experiment are given. ESRO

N68-37201# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.

TESTING IN A STRATOSPHERIC BALLOON OF A SEMICONDUCTOR DETECTOR ALTIMETER [ESSAI EN BALLON STRATOSPHERIQUE D'UN ALTIMETRE EMPLOYANT UN DETECTEUR SEMICONDUCTEUR]

Louis Gilly and Paul Jourdan Jun. 1968 13 p refs In FRENCH; ENGLISH summary

(CEA-R-3516) CFSTI: HC$3.00/MF$0.65

An altimeter containing a semiconductor detector has been operated during flight of a stratospheric balloon. During this assay two apparatus have been used. The first allowed to follow the balloon during its ascension and descent, the second to follow its evolution at its maximum altitude. Information transmitted by radio and recorded on magnetophon, have been studied after the flight. Results are identical with those given by the barometer used by the C.N.E.S. in this trial. Author (ESRO)

N68-37218 Bolkow Entwicklungen K. G., Munich (West Germany).

CHECKOUT-SYSTEMS FOR SATELLITES WITH SCIENTIFIC PAYLOAD

Edgar Reifer 16 May 1968 22 p Presented at the 8th European Space Symp., Venice, 27-29 May 1968

(RF-94-0)

General points of view for the design of checkout-systems are illustrated and a summary of the tasks, the use and test philosophies for these systems are given. The main part deals with the checkout system's mode of application, structure and mode of operation. Checkout systems for components, for integration and system tests are discussed. The possibility of a manually and manually/automatically operated and controlled checkout system for integration and system tests are shown and corresponding technical programs explained. Selftests of checkout systems are described. The checkout systems for the satellite 625 AI-AZUR are specified as examples. Author

N68-37266# Royal Aircraft Establishment, Farnborough (England).

A CHEAP SENSITIVE LEAK-DETECTOR

W. N. Mair and R. W. Bramham May 1968 21 p refs

(RAE-TR-68099) CFSTI: HC$3.00/MF$0.65

The principles and use of a simple leak-detector are described. A small, liquid-nitrogen cooled, zeolite adsorption pump is used to allow helium, used as a probe gas, to reach an ionization gauge while protecting it from other gases in the vacuum system. The leak-detection sensitivity of a helium-probed ionization-gauge is thus increased by allowing the use of a more sensitive range. The potential of the detector was assessed in experiments in which the zeolite pump alone maintained a vacuum system pressure of about 1 mtorr against an air leak of 6.5×10^{-4} torr litre sec^{-1} (0.65 lusec): it was found that the pressure in a protected gauge was of order 10 μtorr and that, for at least 2 hours, the rate of pressure rise in the protected gauge was about 1/4 μtorr/min. Thus zeolite-protection allows the use of an ionization gauge for leak hunting when the in-leakage is great enough to produce a pressure which is too high for normal ionization-gauge operation; and the protection is effective for a time adequate for most leak hunts. It is estimated that, on small vacuum systems, leaks of order 10^{-7} torr litre sec^{-1} (10^{-4} lusec) should be readily located using a helium probe. Author (ESRO)

N68-37280*# University Corp. for Atmospheric Research, Boulder, Colo.

STRUCTURAL MEASUREMENTS ON BALLOONS IN FLIGHT

Karl H. Stefan Natl. Center for Atmospheric Res. Jul. 1968 27 p ref
(Contract NASr-185)
(NASA-CR-97268; NCAR-68-140) CFSTI: $3.00 CSCL 14B

An instrumentation system was designed to collect data, during a balloon ascent, on balloon environment, shape, film strain, and film temperature. The total system is described, as are the sensors and techniques for using them. Limited data collected from three flights indicate that the system will provide a powerful tool for diagnosis of balloon problems. Author

N68-37321*# American Science and Engineering, Inc., Cambridge, Mass.
APOLLO X-RAY ASTRONOMY EXPERIMENT (S-17) Qualification Test Report
28 Nov. 1966 120 p
(Contract NAS9-4841)
(NASA-CR-92325; ASE-1455) CFSTI: $3.00 CSCL 14B

The qualification test program is described that was conducted on the Apollo X-ray Astronomy Experiment (S-17) to verify the inherent capability of the design to meet the performance and environmental requirements of the contract. It includes a description of each test performed, data and results obtained, analyses of all failures, and conclusions. Where possible copies of the actual test data have been included. However, this was not possible in some cases due to the bulk of the records. In these instances the data has been summarized. Author

N68-37326*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
ADVANCED AIR DATA SENSING TECHNIQUES
Rodney K. Bogue and Lannie D. Webb [1968] 33 p refs Presented at the 5th Intern. Aerospace Instr. Symp., Cranfield, England, 25–28 Mar. 1968
(NASA-TM-X-61115) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Flight evaluation data are presented on the use of a fluidic temperature sensor for measuring total temperature on the X-15 aircraft traveling at hypersonic speeds within the atmosphere. The oscillator in the fluidic sensor is described as an adaptation of a bistable fluid amplifier; the tendency of the fluid stream to attach itself to a nearby wall (the Coanada effect) forms the basis of operation. Laboratory calibration checks and simulation tests are discussed, and details are given on the X-15 sensor mount and cooling equipment. Procedures for flight data recording and reduction are outlined. Discrepancies between the shielded thermocouple measurement of total temperature and the fluidic probe measurement are analyzed, and problem areas are identified. It is concluded, however, that the flight test data establish the feasibility of fluidic temperature sensors. M.G.J.

N68-37412*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY INSTRUMENTS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 143–151 (See N68-37397 23-11)

Reported are studies focusing on the development of (1) an atmospheric entry sampling system for possible use during the terminal descent phase of a Mars entry mission; and (2) a prototype mass spectrometer for planetary atmospheric analysis which will be incorporated into the Capsule Systems Advanced Development (CSAD) program. Design concepts and operational capabilities of each of the proposed instruments are described. S.C.W.

N68-37413*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE INSTRUMENTS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 152–167 refs (See N68-37397 23-11)

Space instruments research is reported which focuses on the development of (1) a pulse height analyzer for space applications; (2) an imaging astronomical photometer with both high photometric accuracy and high spatial resolution (electronic camera system); and (3) the secondary electron conduction (SEC) vidicon for possible application during the Apollo mission and the Apollo Telescope Mount program. S.C.W.

N68-37414*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA SYSTEMS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 169–181 refs (See N68-37397 23-11)

Reported are studies of (1) digital techniques for generating a time-dependent acceleration voltage for a mass spectrometer; and (2) studies focusing on the development of an 8,192-bit woven plated-wire memory for use in the entry data system of the Capsule System Advanced Development (CASD) program. S.C.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-36075*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE LIFE OF 120 mm BORE BALL BEARINGS AT 600°F WITH FLUOROCARBON, POLYPHENYL ETHER, AND SYNTHETIC PARAFFINIC BASE LUBRICANTS
Eric N. Bamberger (G.E., Cincinnati), Edwin V. Zaretsky, and William J. Anderson Washington Oct. 1968 27 p refs
(NASA-TN-D-4850) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Groups of 120-mm bore angular-contact ball bearings made from AISI M-50 steel were fatigue tested at a temperature of 600°F and a speed of 12,000 rpm with a synthetic paraffinic oil, a fluorocarbon, and a 5P4E polyphenyl ether. Under a low oxygen environment, the synthetic paraffinic oil and the fluorocarbon gave bearing lives approximately 14 and 3 times AFBMA-predicted (catalog) life, respectively. With the polyphenyl ether, bearing life was less than AFBMA-predicted (catalog) life in an air environment. For the synthetic paraffinic oil and the fluorocarbon, bearing fatigue was subsurface initiated. For the polyphenyl ether, bearing failure was mainly from surface distress, wear, and superficial pitting. Author

N68-36095*# Martin Co., Orlando, Fla. Advanced Manufacturing Technology Dept.
DESIGN, MANUFACTURE, AND TEST OF INFRARED CROSS WIRE RESISTANCE MICRO-WELDING SYSTEM Final Report, 20 Jun. 1967–20 Mar. 1968
Forest C. Deal Mar. 1968 26 p
(Contract NAS8-21221)
(NASA-CR-61980; OR-9314) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An engineering prototype IR Weld Evaluator was designed and built to operate in a factory environment. Off-the-shelf components were used to facilitate ease of maintenance and replacement. The system evaluated crosswire micro welds and lockup to prevent additional welds when an unacceptable weld was made. Manuals were furnished to show the operation, maintenance, and calibration procedures. Author

N68-36098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INCOMPRESSIBLY LUBRICATED RAYLEIGH STEP JOURNAL BEARING. 1: ZERO-ORDER PERTURBATION SOLUTION
Bernard J. Hamrock and William J. Anderson Washington Oct. 1968 33 p refs
(NASA-TN-D-4839) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A theoretical analysis of the pressure distribution, load capacity, load angle, and friction force for a single-step concentric journal bearing is performed. The resulting expressions were evaluated on a digital computer. The maximum load capacity is obtained when the ratio of the step clearance to ridge clearance is 1.7 and the ratio of the angle subtended by the ridge to the angle subtended by the pad is 0.35. Finally, for relatively small radius-to-length ratios, the load capacity of the stepped journal, while concentric, is higher than the load capacity of a finite-length Sommerfeld bearing operating with an eccentricity ratio of 0.1. Author

N68-36217# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
WEAR AND FRICTION EVALUATION MACHINE
Joseph Viglione and Walter F. Worden 19 Apr. 1968 47 p refs
(NADC-MA-6802; AD-673534)

The report describes the function and capabilities of a reciprocating type wear and friction evaluation machine equipped with high temperature facilities. Reported are exploratory type evaluation test runs on titanium alloys, type H-11 steel and 410 stainless steel, as received, and in some cases, with lubrication and metallic coatings. Author (TAB)

N68-36225# Road Research Lab., Crowthorne (England).
A METHOD OF MEASURING THE TENSIONS IN BOLTS
D. S. Moss 1968 16 p refs
(RRL-LR100; PB-178739) CFSTI: HC $3.00/MF $0.65

High strength friction grip bolted connections depend for their strength upon friction at the interfaces of faying surfaces. An essential requirement in the experimental work is an accurate measurement of the tension in each bolt of the assembled joint. A method of measuring bolt tension has been developed in which the bolt is fitted with an internal rod, which remains unstressed when the bolt is loaded by tightening the nut. As the bolt extends under load, relative movement occurs between the free end of the rod and a reference-plane on the bolt head. This movement may be measured and related to bolt tension by calibrating the bolt against a suitable load cell. Author (USGRDR)

N68-36243# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
STABILIZER ACTUATOR BEARINGS FOR 600°F OPERATION
W. D. Craig, Jr. Aug. 1968 26 p refs
(FSN-AD5-05-68-4)

Material and design studies of self-aligning bearings which can be used in powered flight control actuators at temperatures up to 600°F are discussed. Various configurations and materials are discussed. Effect of bearing design on pivot joint weight is shown and various deficiencies are noted. A possible bearing design for a 125,000 lb operating load is detailed. This self-lubricated, spherical bearing made of a silver-carbon composite and ceramic coated stainless steel provided the most suitable design for minimum weight and size of pivot joint at a 600°F. Author

N68-36254*# Rocketdyne, Canoga Park, Calif.
INVESTIGATION OF POSITIVE-TYPE SHAFT SEALS Interim Report
R. R. Hammond 25 Sep. 1968 26 p
(Contract NAS8-11325)
(NASA-CR-97143; R-6811-1) CFSTI: HC $3.00/MF $0.65 CSCL 11A

A series of new type seal concepts were generated, and three of the most promising were detailed for fabrication and testing to evaluate the designs for future turbo-pump applications. Descriptions of the various concepts, basis for the final selections of the seals for evaluation, and results of testing are included. Author

N68-36285# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COLD METALWORKING WITH MILLING CUTTERS AND LIQUID-METAL STAMPING [KHOLODNAYA OBRABOTKA METALLA FREZAMI I SHTAMPOVKA ZHIDKOGO METALLA]
S. Shirokov 4 Oct. 1967 9 p refs Transl. into ENGLISH from Vystavka Dostizh. Narodnogo Khoz. (USSR), No. 11, 1966 p 38–39
(FTD-HT-23-764-67; AD-673458)

There were many devices and mechanisms of interest to specialists at the exhibit of the work of innovators, rationalizers and inventors of the electrical equipment industry at the All-Union House of the National Economy. Author (TAB)

N68-36386# McDonnell-Douglas Co., Santa Monica, Calif. Missile and Space Systems Div.
A UNIQUE COMPUTER PROGRAM FOR RELIABILITY MATHEMATICAL MODELLING
R. H. Kirk and P. H. Mueggler Dec. 1967 25 p
(Douglas Paper 4757)

To design reliability into a product the designer must have quantitative reliability criteria as he is developing his design. The reliability mathematical model is a major source of these quantitative criteria. If the mathematical model is developed manually, the quantitative criteria are usually provided too late, and the designer is reluctant to use them. Because of this situation, calculations for the failure probability analysis and the combined subsystem reliabilities of missiles were set up on a computer program designated OA28, which calculates and prints in report form a reliability analysis of any system for any given set of parameters. It presents a rapid and accurate method for evaluating the effects of design changes and the prediction of system reliability under various environmental conditions. This paper describes the OA28 program, discusses its unique features, and illustrates its application and capability. Author

N68-36564*# TRW Equipment Labs., Cleveland, Ohio.
INTEGRAL LUBRICATION PUMP DEVELOPMENT. CONTINUED DEVELOPMENT OF A HYPERGOLIC ELECTRICAL POWER SYSTEM Final Report, Apr. 1967–Jan. 1968
Jan. 1968 18 p Suppl.
(Contract NAS9-6879)
(NASA-CR-92309; ER-7249-1) CFSTI: HC $3.00/MF $0.65 CSCL 13K

The work performed in the development of hypergolic turboalternator power system is summarized in relation to efforts directed toward finalizing and verifying the design of a flight-type system for use as a complimentary Lunar Module electrical power system to extend LM stay time. The results of component and flight system development and two 100 hour system endurance tests are reported. The integral pump design is briefly described, and the results of a pump test conducted to demonstrate the feasibility of the integral lubrication design are given. B.S.D.

N68-36605# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT CONSTRUCTION AND AVIATION TECHNOLOGY
11 Aug. 1967 24 p refs Transl. into ENGLISH from Samoletostroyeniye i Tekhn. Vozdushnogo Flota (USSR), no. 6, 1966 p 107–109, 120–123
(FTD-MT-24-129-67; AD-673169)

CONTENTS:

1. METHOD OF DETERMINATION OF SHAPE OF BLANK IN THE PROCESS OF STAMPING A. I. Lopatin, V. G. Kas'yan, and V. N. Zhendubayev p 1–6 refs (See N68-36606 23-15)

2. DETERMINATION OF VELOCITY FIELD AND RATES OF DEFORMATIONS WHEN PRESSING THROUGH A RECTANGULAR DIE (METHOD OF FLOW LINES) T. I. Glebov p 7–13 refs (See N68-36607 23-15)

N68-36606# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF DETERMINATION OF SHAPE OF BLANK IN THE PROCESS OF STAMPING [METOD OPREDELENIYA FORMY ZAGOTOVKI V PROTSESSE SHTAMPOVKI]
A. I. Lopatin, V. G. Kas'yan, and V. N. Zhendubayev *In its* Aircraft Construct. and Aviation Technol. 11 Aug. 1967 p 1–6 refs (See N68-36605 23-15)

A method for determining the shape of a workpiece by measuring the time for sequential operation of contact pickups mounted on a single level is described. When the blank moves at the rate of several hundred meters per second and at a slight curve, the measurement of short time intervals becomes problematic. A pulse count chronometer with capacitor time transformer is proposed for measuring these time intervals. A formula is given for determining the relative error in the measurement of short time intervals using this type of instrument. The error is determined by the time transformation factor. K.W.

N68-36607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF VELOCITY FIELD AND RATES OF DEFORMATIONS WHEN PRESSING THROUGH A RECTANGULAR DIE (METHOD OF FLOW LINES)
T. I. Glebov *In its* Aircraft Construct. and Aviation Technol. 11 Aug. 1967 p 7–13 refs (See N68-36605 23-15)

A method is proposed for studying the internal velocities and accelerations of vacancies and particles during plastic deformation of the workpiece in extrusion through a rectangular die. To find a flow function which gives a velocity field corresponding closely to experimentally observed velocities, the die–container system is broken up into three zones. Error reduction and the plane problem are considered. It is shown that extrusion with low external friction requires calculation of the velocity field and stresses in one of the zones only. A simple flow function is found for this zone as well as the velocity field and average stress with consideration to the condition of continuity. K.W.

N68-36619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF PLASTIC DEFORMATION IN THE WELDING PROCESS ON THE STRENGTH OF WELDED JOINT CONNECTIONS [VLIYANIE PLASTICHESKOGO DEFORMIROVANIYA V PROTSESSE SVARKI NA PROCHNOST SVARNYKH STYKOVYKH SOEDINENII]
I. P. Zamyatin 30 Aug. 1967 17 p refs Transl. into ENGLISH from Svarachnoye Proizvodstvo (Moscow), no. 262, 1966 p 56–64
(FTD-MT-24-157-67; AD-673412)

Investigations were conducted on alloyed steel to determine the value of plastic deformation in the welding process. Results of the investigation showed that plastic deformation in the welding process opens new possibilities of improving the mechanical indices of welded joints. Author (TAB)

N68-36644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE APPLICATION OF ULTRAHIGH VACUUMS
Chung-I. Hua 31 Aug. 1967 14 p Transl. into ENGLISH from K'O Hsueh Hua Pao (Chinese People's Republic), no. 12, 1963 p 445–448
(FTD-HT-67-214; AD-673757)

Contents: Ultra-clean surfaces; The new guard in electron tubes; The necessary conditions for thermonuclear reactions; Artificial interstellar space; Creation of ultrahigh vacuum; Mechanical pumps and diffusion pumps; Ion pumps and titanium pumps; and Condensation pumps. TAB

N68-36666# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASSURED EVALUATIONS OF SYSTEM RELIABILITY WITH INCOMPLETE INFORMATION CONCERNING RELIABILITY OF ELEMENTS [O GARANTIROVANNYKH OTSENKAKH NADEZHNOSTI SISTEMY PRI NEPOLNYKH SVEDENIYAKH O NADEZHNOSTI ELEMENTOV]
Yu. B. Germeyer, D. S. Irger, and E. P. Kalabukhova 20 Sep. 1967 25 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 6, no. 4, 1966 p 733–747
(FTD-HT-67-463; AD-673758)

It is conventional to consider the complete characteristic of the reliability of a system (or element) to be function P(t), i.e., the probability of troublefree operation of the system (or element) during time t. Reliability theory examines the following basic operations on the laws of distribution of P(t), at any value of t: sequential combination of n elements; parallel combination of n elements; combination with replacement of elements; and averaging with respect to random operating conditions. The exponential law of reliability has acquired exceptional significance. If this is not used in estimating element reliability there naturally rises the question of how many and what characteristics of P sub e(t) must be known to give well-founded estimates of system reliability; the minimum number of such characteristics is of course desired. The specific problem in this paper is to explain what may be guaranteed in the sense of knowing P(t) in combinations of the above types if some of the listed characteristics are known about Pe(t). TAB

N68-36701# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PUNCHING OF BLANKS, HEATED IN MOLTEN GLASS [SHTAMPOVKA ZAGOTOVOK NAGRETYKH V RASPLAVLENNOM STEKLE]
V. M. Klyuev, A. N. Ostolopovskii, and E. G. Shadek 17 Nov. 1967 13 p refs Transl. into ENGLISH Kuznechno-shtampovochnoye Proizv. (USSR), v. 8, no. 10, 1966 p 36–39
(FTD-HT-23-929-67; AD-673449)

Experimental investigations of the punching of blanks, heated in molten glass, were carried out by the laboratory of metal processing by pressure in combination with another project. In the role of protective and technological medium for heating under punching, glass melts were adopted and a melt of window glass, as well as enamel melts. Author (TAB)

N68-36732# General Electric Co., St. Petersburg, Fla. Pinellas Pensula Plant.
PRESSURES GENERATED DURING THE FOAMING OF A POLYURETHANE RESIN

C. C. Scheid 27 Oct. 1967 12 p ref
(Contract AT(29-1)-656)
(GEPP-11; R-67NDB) CFSTI: HC $3.00/MF $0.65

During foaming of Lockfoam BX-105-B10, carbon dioxide is generated and can result in component or container damage if pressure is excessive. In a given container assembly, foam pressures are small (only 20 psi maximum) compared to those resulting from temperature cycling during environmental testing. Increases in foam pressure correlate with increases in exothermic temperature rise. Effective reduction in foam pressure is achieved by increasing the number of container vent holes and the container heat transfer rate. The test procedure used to determine generated pressures during Lockfoam foaming and the results of testing are described. Author (NSA)

N68-36769# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATISTICAL CHARACTERISTICS OF THE NUMBER OF STROKES OF PROPER WORK OF A LOGICAL AUTOMATIC MACHINE DURING THE APPEARANCE OF FAILURE [STATISTICHESKIE KHARAKTERISTIKI CHISLA TAKTOV ISPRAVNOI RABOTY LOGICHESKOGO AVTOMATA PRI POYAVLENII NEISPRAVNOSTI]
A. Sklyarevich and E. Tsvetkova Sep. 1967 17 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 3, 1966 p 35–43
(FTD-MT-24-180-67; AD-673451)

Equations have been obtained by which distribution sequences of cycles of an automatic machine are determined in the transitional and established (from the statistical viewpoint) modes of its work. A method is given of determining the statistical characteristics of the number of cycles of correct work of an automatic machine after the appearance of failure in it. TAB

N68-36800# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ULTRASONIC ISOTOPE HEAT SOURCE TESTER
B. E. Dozer 21 Sep. 1967 45 p
(Contract AT(45-1)-1830)
(BNWL-CC-1238L) CFSTI: HC $3.00/MF $0.65

An ultrasonic tester was developed to test cylindrical isotope fuel elements for wall weld penetration and cracks, wall defects, and to measure the wall thickness. The tester consists of an electronic console and a mechanical device to rotate the sample. The electronic console is made up of electronic pulse processing equipment, a transducer location system, and X-Y recorder, a pulse time measurement system, motor controllers, and miscellaneous electronic equipment. The mechanical rotating device is a 14-inch metal lathe with the tail stock and tool post removed and the motor changed to reduce the lathe's minimum speed. A water tank was added to allow the chuck to rotate the piece being tested under water, and a transducer drive mechanism was added to the tool post carriage. In addition to this, various devices were incorporated to drive the readout circuitry. Author (NSA)

N68-36865# Sandia Corp., Albuquerque, N. Mex.
MACHINE TOOL OPERATIONS WITHIN IMOG AGENCIES
E. P. Quigley Nov. 1967 16 p
(Contract AT(29-1)-789)
(SC-DC-67-2355) CFSTI: HC $3.00/MF $0.65

The past problems, current development, and future needs of the IMOG (Interagency Mechanical Operations Group) agencies are discussed. Past problems principally involved inadequate communication, but a few typical examples of equipment difficulties are also cited. Current developments are generally aimed at acquiring a better understanding of the characteristics of new technologies such as hydrostatic bearings, to see if it would be advantageous to use them. Future needs are forecast to enable machine tool builders to plan ahead for new equipment and to provide a basis for better communication. Author (NSA)

N68-36867# Mound Lab., Miamisburg, Ohio.
METALLOGRAPHIC EXAMINATION OF PLUTONIUM DIOXIDE MICROSPHERES
M. D. Kelly and P. A. Tucker [21 Dec. 1967] 14 p ref Presented at 21st AEC Metallogr. Group Meeting, Upton, N. Y.
(Contract AT(33-3)-GEN-53)
(CONF-670533-8) CFSTI: HC $3.00/MF $0.65

The structural integrity of plasma-fired plutonium dioxide microspheres has been investigated by metallographic techniques. The microspheres are highly susceptible to edge rounding and brittle plucking during grinding and polishing. A technique is described which eliminates these problems. Cross-sectioned, polished and etched microspheres are illustrated. Author (NSA)

N68-36954# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
FAILURE PREDICTION BY LUBRICANT ANALYSIS
N. H. Miller 18 Dec. 1967 4 p Presented at 10th ASME Plant Eng. and Maintenance Conf., Detroit, 10–12 Apr. 1967 Submitted for publication
(Contract AT(29-1)-1106)
(RFP-926; CONF-670441-1) CFSTI: HC $3.00/MF $0.65

The proper selection, analysis, and replacement of lubricants and hydraulic fluids are integral parts of the maintenance demanded by modern automated and ultrahigh precision machines. Analysis of lubricants in use with spectrographic and infrared methods can indicate equipment deficiencies and forecast possible failures. Testing and care of hydraulic fluids before use will help avoid trouble later. Performance tests of hydraulic fluids and other lubricants will produce useful, money saving data. Daily preventative maintenance schedules that include programmed equipment lubrication reduce down time and increase on-stream efficiency. Author (NSA)

N68-36980# Technische Hochschule Hannover (West Germany).
ANGLE AND CUTTING CONDITIONS OF JEWELED AND SINTERED TOOLS TO OBTAIN POLISHED SURFACES ON VARIOUS MATERIALS (MIRROR FINISHING) [WINKEL UND SCHNITTBEDINGUNGEN AN SPANENDEN EDELSTEIN-UND SINTERWERKZEUGEN, UM BEI VERSCHIEDENEN WERKSTOFFEN POLIERTE OBERFLAECHEN ZU ERREICHEN (GLANZDREHEN)]
Ernst August Weinz (Ph.D. Thesis) 1967 224 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Cutting tools of diamond, sapphire, ruby, or sintered aluminum oxide ceramic materials were evaluated for their performance in mirror polishing and burnishing of various materials. Optimal angle and cutting results were obtained with single crystal tools having either a finely sharpened diamond edge or a combination aluminum oxide-sapphire-ruby edge. The latter group of tools were found feasible for soft synthetic materials and lacquers and found application in the record cutting industry. Overall tests proved conclusively that definite mirror imprints formed when a finely polished single crystal cutting edge possessed a very small action free angle of about 1° to 3° and a negative cutting angle of about −2 ÷ −10°. Transl. by G.G.

N68-37098# Oak Ridge National Lab., Tenn.
MOLTEN-SALT FLUORIDE VOLATILITY PILOT PLANT: EQUIPMENT PERFORMANCE DURING PROCESSING OF ALUMINUM-CLAD FUEL ELEMENTS
R. G. Nicol and W. T. Mc Duffee Jul. 1968 36 p refs
(Contract W-7405-ENG-26)
(ORNL-4251) CFSTI: HC $3.00/MF $0.65

Irradiated aluminum-clad fuel elements were successfully processed in the Molten Salt Volatility Pilot Plant. The rate of equipment failure and the levels of necessary equipment maintenance were comparable to those observed previously with zirconium- or Zircaloy-clad fuels. None of the runs had to be terminated because of equipment failure. Author (NSA)

N68-37099# Mechanical Technology, Inc., Latham, N. Y.
FLUID DYNAMICS OF DISPERSED TWO-PHASE VAPOR-LIQUID FLOW IN LUBRICANT FILMS, PARTS 1 AND 2
N. Zuber and D. E. Dougherty Mar. 1968 71 p refs
(Contract AT(30-1)-3839)
(MTI-68-TR-30; NYO-3839-2) CFSTI: HC $3.00/MF $0.65

A non-equilibrium two-phase film flow model was developed. The model postulates that evaporation and/or condensation of liquid droplets entrained in a vapor film flow is determined by the thermal driving potential of the internal droplet temperature and the local time varying surface saturation temperature of the droplets. The model is applicable to the analysis of steam lubricated bearings. A constitutive equation of condensation and/or evaporation was obtained for a two-phase film flow including the effects of a non-equilibrium change of phase. This constitutive equation combined with the field equations of the two-phase Reynolds' film flow complete the equation for the static and dynamic film pressure profiles and flow rates. The steady state, one-dimensional evaporate film flow was analyzed. NSA

N68-37115# Royal Aircraft Establishment, Farnborough (England).
A REVIEW OF PNEUMATIC PISTON TYPE ACTUATORS FOR PROSTHETICS
A. G. Earl Feb. 1968 32 p ref
(RAE-TR-68027) CFSTI: HC $3.00/MF $0.65

The gas consumptions of several arrangements of piston type actuators when operating under various loads are calculated. It is shown that a differential area type actuator operating with the piston rod normally in tension is markedly more economical than other arrangements, particularly when operating against uni-directional loads. When operating against bi-directional loads this design still uses less gas than a conventional double-acting actuator. Several recommendations are made on design aspects as a result of the practical implications revealed by these calculations. Author (ESRO)

N68-37164# Atomics International, Canoga Park, Calif.
ZAPPER: A DEVICE FOR REPAIRING OPEN-CIRCUITED THERMOCOUPLES
E. L. Babbe 3 Jun. 1968 6 p refs
(Contract AT(04-3)-701)
(AI-AEC-MEMO-12710) CFSTI: HC $3.00/MF $0.65

A device to weld remote breaks in thermocouples has been developed. It is an adjustable capacitive discharge welding machine capable of repairing thermocouples attached to in-pile irradiation experiments where accessibility is not possible. Author (NSA)

N68-37179# Sandia Corp., Albuquerque, N. Mex.
PULSED ARC SPOT WELDER
M. J. Davis Nov. 1967 15 p
(Contract AT(29-1)-789)
(SC-DR-67-725) CFSTI: HC $3.00/MF $0.65

The design and operation of a tungsten inert gas arc spot welder are described. Arc durations from 0.005 to 0.040 second are available with peak currents varying from 8 to 240 amps. Examples of typical applications are given. The equipment is used for the assembly of small electrical and mechanical devices. Author (NSA)

N68-37214*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
CRITICAL SPEED ANALYSIS OF RIGID ROTORS ON FLEXIBLE FOUNDATIONS
Richard H. Cavicchi Washington Oct. 1968 47 p refs
(NASA-TN-D-4858) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A critical speed analysis of undamped rigid rotors on flexible foundations reveals four conical mode solutions comprising forward and backward precession. There is also a two solution bouncing mode set dependent only on foundation to rotor mass and spring constant ratios. Although analysis of a firm foundation model omits two of the four conical mode solutions, close agreement exists between the two corresponding solutions. The flexible foundation analysis reduces to a simple firm foundation result when the foundation to rotor spring constant ratio is zero or infinite. Only three calculations are needed in this range to cover all intermediate values. Author

N68-37239*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THE ROLE OF CHEMICAL REACTIONS IN THE MECHANISM OF COMMINUTION OF DUCTILE METALS INTO ULTRAFINE POWDERS BY GRINDING
Alan Arias Washington Oct. 1968 32 p refs
(NASA-TN-D-4862) CFSTI: HC $3.00/MF $0.65 CSCL 13H

On grinding in pure water, zirconium, tantalum, iron, and stainless-steel powders were extensively comminuted and simultaneously oxidized with hydrogen release, whereas nickel, copper, and silver powders did not react with water and their particle sizes increase. On grinding nickel, copper, and silver in water pressurized with oxygen, nickel and copper became extensively comminuted and were oxidized, whereas silver did not react with oxygen and its particle size increased. From these results and other considerations, it is hypothesized that for extensive comminution of ductile metals and alloys to occur on grinding they must react with the grinding media. Author

N68-37270# National Research Council of Canada, Ottawa (Ontario). Technical Information Service.
STRENGTH OF SOLDERED JOINTS
[1968] 4 p
(Rept.-40-56)

An overview is presented on the factors involved in determining the ability of a soldered joint to withstand shearing stress, and results of studies on the shear strength of a modified sleeve joint are summarized. The findings indicate that, in general, visual inspection cannot detect the quality of a joint made by soft soldering. Also discussed is a sampling plan adopted for visual inspection to detect loose soldered joints. The statistical theory of the method indicates that no more than 1 in 10,000 soldered connections will leave the factory in defective condition, provided that equipment found to have a loose connection is replaced or repaired immediately. M.G.J.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-36045 Cornell Univ., Ithaca, N. Y.
EXCITATION MECHANISMS IN THE IONIZED ARGON LASER
Robert Irving Rudko (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-17251

The absolute intensities of all the important spontaneous emission lines in ionized argon in the visible and ultraviolet region were measured. Using these measured results and the transition probabilities for each measured transition the following basic numerical results were obtained and presented: (1) The energy radiated per cc of gas in the argon laser discharge for each important transition in the visible or ultraviolet region. (2) The population densities of all the 4s, 4p, 4d and 5s states in ionized argon. (3) The total pumping rate of the 4p states and the portion of the total pumping rate due to cascade transitions; the remainder being due to collisions. (4) The gain of the important laser lines. These results were used to determine the important physical mechanisms taking place in the ionized argon laser. Dissert. Abstr.

N68-36061 Stanford Univ., Calif.
THE STIMULATED RAMAN EFFECT AND ITS APPLICATION AS A TUNABLE LASER
Harold Edward Puthoff (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17486

The theory and design is based on the use of an off-axis resonator system in which the Raman and laser beams are not collinear. The tunable laser is shown to be a threshold device which provides for the conversion of power at the laser frequency into power at the Raman frequency in accordance with the usual parametric device Manlye-Rowe relationships. Experimental verification of the theory and design is presented, demonstrated that the stimulated Raman effect in an off-axis resonator system behaves as predicted. The results indicate that the construction of a tunable Raman laser based on the 628 cm^{-1} transition in $LiNbO_3$ is feasible. Under present state-of-the-art conditions an estimated laser pump power $\approx$ 4 Mw/cm^2 for a crystal $\approx$ 0.5 cm long is required to reach threshold. Dissert. Abstr.

N68-36166*# International Business Machines Corp., Huntsville, Ala. Federal Systems Div.
LASER AIMING SIMULATION (LASIM) Final Report, Feb. 1967–May 1968
F. G. Milligan, R. L. Dobson, and G. M. Groome 20 May 1968 191 p refs
(Contract NAS8-21033)
(NASA-CR-61975; IBM-68-K10-0006) CFSTI: HC $3.00/MF $0.65 CSCL 20E

A detailed digital simulation is developed for the tracking and pointing performance of a spaceborne laser communications system experiment (LCSE) in synchronous earth orbit. Known as the laser aiming simulation (LASIM), the program is devoted to simulation of dynamics and control functions. Included are mathematical models of the orbital and rotational motion of the spacecraft, control moment gyroscopes, and the laser telescope. The control portion consists of the three tracking control systems and the point-ahead system. Capability for assessment of hardware imperfection effects on total system performance is provided. The mathematical formulations derived to depict the prototype hardware and system dynamics, from which the digital program was written, are presented. Analysis of LASIM data is presented in connection with assessing the ultimate feasibility of the LCSE operation. D.A.E.

N68-36194#
UTILIZATION OF A LASER INTERFEROMETER TO DETERMINE THE ELECTRON CONCENTRATION IN PLASMA JETS
A. A. Ovsiannikov, L. S. Polak, R. E. Rovinskii, and A. G. Rozanov [1968] 4 p refs Transl. into ENGLISH from Zh. Prikl. Spektr. (Moscow), v. 7, no. 2, Aug. 1967 p 198–201
CFSTI: HC $3.00/MF $0.65

The laser interferometric methodology can be adapted for the diagnostics of a stationary discharge plasma by producing a short-range degree of modulation of the discharge, or by making the measurement at the time of switching the discharge on and off. Results of measuring the electron concentration by using a laser interferometer in an argon plasma jet escaping into the atmosphere from the nozzle of a direct current arc plasmatron are presented. Author

N68-36226 Stanford Univ., Calif.
THE APPLICATION OF LASER SPECTROSCOPY TO THE DETERMINATION OF THE VELOCITY DISTRIBUTION FUNCTION OF A GAS
Munson Arthur Kwok (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17451

The changes in the resonance absorption line profiles of the 6328 Å transition of Ne^{20} have been studied as a function of the pressure (1 to 10 torr) and the current (15 to 75 mA) of a DC cold cathode discharge. The behavior of the line shape and line parameters enables one to estimate the relative influences of the Doppler and non-Doppler causes of broadening. The absorption measurements were made with a method previously developed using a tunable, unimode He–Ne laser as the light source passing through the gas into a photo cell. Due to the extreme monochromaticity of the laser, the absorption line profile is determined when the device is tuned. Interpretation of the various contributions is made by relating the data to Voigt functions. The emission measurements are recorded with a monochromator and phototube system which has been appropriately calibrated. Use of the absorption and emission measurements in calculations gives the number densities of the various states. Dissert. Abstr.

N68-36227*# International Business Machines Corp., Huntsville, Ala. Federal Systems Div.
LASER AIMING SIMULATION (LASIM). VOLUME 2: PROGRAMMERS AND USERS' MANUAL Final Report
20 May 1968 183 p
(Contract NAS8-21033)
(NASA-CR-61976; IBM-68-K10-0006, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Program functions and logic are described to illustrate the use of the laser aiming simulation (LASIM) modularized programs, which are written in double precision FORTRAN 4, version 13, for the IBM 7094 computer. The operation of the fine tracking system, the telescope control system, and the spacecraft attitude control system are simulated by LASIM program subroutines. In addition, simulation of the physical dynamics of the mass elements comprising the laser communications system experiment (LSCE) in response to hardware actuation is accomplished. Simulation of the pointing operation is contained within a separate program called the pointing control program, and is discussed in detail. The functions performed by the LASIM program and major program logic are represented through flow charts. D.A.E.

N68-36255# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
OPTICAL PUMPING FOR MILLIMETER-WAVE MASERS
John C. Clark and Richard W. Grow Jun. 1968 150 p refs
(Grant NSF GK-29)
(UTEC-MD-68-053; NSF-17)

Optical pumping may be used to obtain large population differences in a steady-state condition at any temperature. Because high optical powers are available, it can provide a very useful pump source for millimeter wave masers. In this report four different models of optical pumping schemes are presented and a rate equation analysis of each is given. The four models analyzed are the three level external optical pump, the broadband pumping of a

dichroic material, and two cases of four level internal pumping, with and without lasing into the upper level of the maser transition. The internal pumping scheme where lasing occurs to the upper level of the maser transition is shown to be the most suitable technique for obtaining an optically pumped millimeter wave maser where suitable materials are available. A survey of solid state materials with zero field splittings in the millimeter wave region is given and several are considered as potential candidates for this application. Author

N68-36282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSED ELECTRODELESS DISCHARGE AS A LIGHT SOURCE FOR LASER EXCITATION AND OBSERVATION OF THE CHARACTERISTICS OF LASER OUTPUT
Zung-Kui Chang and Mow-Foh Yeh 3 Nov. 1967 17 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (China), v. 22, no. 2, 1966 p 174–182
(FTD-HT-67-392; AD-673840)

An experiment was conducted to study the characteristics of electrodeless discharge tubes for use in ruby and Nd-glass laser operation. A discharge loop composed of a high-voltage low-inductance capacitor, a 2-3 microhenry primary inductance coil with multiple turns, and a coaxial quartz discharge tube was used. The discharge tube was filled with xenon or argon at 10 mm Hg or more. Discharging period was found to be 10 microsec or more using a type MY-50-3 capacitor of 0.2 microhenry internal inductance. The period can be decreased with a type MY-110-0.022 capacitor. Emission spectra of discharge tubes at various pressures and voltages were obtained with a quartz spectrograph. Analysis was made for emission spike, frequency mode, quasicontinuous damped oscillation, and threshold value of laser output. Application of electrodeless discharge tubes to lasers led to the following conclusions: (1) high-energy input is possible in discharge tubes; (2) repetition frequency of lasers is raised; (3) higher pumping efficiency with higher power can be achieved; (4) the discharge tube has a longer service life; and (5) emission spectra can be matched with absorption bands of various laser materials. Author (TAB)

N68-36305 Stanford Univ., Calif.
THE STIMULATED RAMAN EFFECT IN AN OFF-AXIS RESONATOR
Bernard Gene Huth (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17442

The generation of stimulated Raman effect in an off-axis resonator is investigated both theoretically and experimentally. A semi-classical analysis starts from Placzek's approximation and results in an equation for the expectation value of the electronic polarizability. The system of equations formed when this is combined with the electric field equations for the laser and Stokes waves is solved for both steady state and transient cases. It is seen that threshold does not depend upon the exact intensity profile of the laser, but rather on an average intensity. Therefore, in sharp contrast to traveling wave experiments, the behavior of the off-axis system is independent of the self-focusing properties of the liquid Raman media. Experiments with benzene, a self-focusing liquid, and cyclohexane, a non-self-focusing liquid, show very good quantitative agreement with the theoretical results. Dissert. Abstr.

N68-36339# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF LASER LINE PROFILES, PICOSECOND LASER IMPULSES Annual Report, 1 Aug. 1967–31 Jul. 1968
Michael J. Brienza, Anthony J. DeMaria, William H. Glenn, Jr., George L. Lamb, Jr., Michael E. Mack et al 28 Aug. 1968 80 p refs
(Contract N00014-66-C-0344; ARPA Order 306; Proj. Defender)
(G-920479-8; AR-2; AD-673858)

The report covers work under Contract N00014-66-C0344 for the period 1 August 1967 to 31 July 1968. Topics discussed include theoretical and experimental work on the propagation of ultrashort pulses, measurement of nanosecond fluorescent decay times, light amplification in saturable absorbers, adiabatic inversion of quantum states, optical rectification and mode-locking of organic dye lasers. Author (TAB)

N68-36341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STRUCTURE OF THE LIGHT STIMULATOR
Ming-Kao Ho 31 Aug. 1967 12 p Transl. into ENGLISH from K'O Hsueh Hua Pao (Chinese People's Republic), no. 1, 1963 p 11–12, 30
(FTD-HT-67-215; AD-673652)

The document describes briefly the operation of the laser and methods used to improve its power output. TAB

N68-36475# Bell and Howell Research Center, Pasadena, Calif. Research Labs.
INDIUM ARSENIDE–PHOSPHIDE INJECTION LASERS Technical Summary Report
Robert K. Willardson, James H. Winkler, and Bernd Ross Mar. 1968 56 p refs
(Contract N00014-68-C-0219)
(AD-673318)

Studies are being made of the alloy system indium arsenide–phosphide (INAS–INP) to produce injection lasers which emit at 1.06 microns at room temperature. Ingots of INAS–INP were grown using both the Czochralski magnetic puller and a modified Czochralski technique in which the crystal is pulled from a melt encapsulated in boron oxide glass. Both methods show promising results, and crystals of INAS–INP were produced which have made possible the postulation of a revised phase diagram for the system. Both lattice parameters and electron carrier concentration and mobility data were obtained for the materials produced. Author (TAB)

N68-36680# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RECENT FOREIGN DEVELOPMENTS IN LASER TECHNOLOGY
Wu-Han Huang 31 Aug. 1967 26 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 2, 1965 p 166–174
(FTD-HT-67-216; AD-673759)

A review is given of non-Chinese laser technology. Topics include: The search for lasing materials; improvement of laser systems and apparatus; high-intensity optics; application of laser techniques (optical locating, optical radar, infrared receiving). TAB

N68-36705 Brandeis Univ., Waltham, Mass.
QUANTUM THEORY OF INTERNALLY MODULATED LASERS
Paul James Titterton (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16583

A quantum theory of the modulation process itself is developed in terms of travelling wave modes of an optical resonator. The theory is able to predict the effect on any wave packet of passing through the modulator in complete quantum mechanical generality.

A saturation analysis of the steady state operation of the AM and FM laser is performed under the assumption that the lasing medium can be represented by a linear response. Under these assumptions, effective gain curves are found for the lasing medium for the multimode AM, single mode AM and the FM cases. It is found that steady state oscillation implies that the AM pulse passes through the modulator at a definite time relative to the distortion of the modulating medium, and that this time is quite different for KDP AM light and quartz AM light if the quartz AM is loss mudulation. The pulse passes through the KDP when it is maximally distorted and through a quartz loss modulator when the crystal is in its equilibrium position. Dissert. Abstr.

N68-36728 Stanford Univ., Calif.
THE ARGON LASER WITH INTERNAL PHASE MODULATION: ITS USE IN PRODUCING SINGLE FREQUENCY LIGHT
Larry Martin Osterink (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-17476

Most laser devices will oscillate simultaneously in a number of optical modes, leading to random amplitude and phase fluctuations of the laser output, among other difficulties. These simultaneous oscillations most often occur in nearly equally spaced axial cavity modes. It has recently been realized that an internal perturbation of the laser cavity which varies with time at or near the axial mode frequency can impose a substantial degree of regularity upon the multimode laser output. While earlier studies have concentrated upon internal amplitude modulation of the laser cavity, this study is concerned with the effects and applications of inserting a time varying phase perturbation inside the laser cavity. This work is a study, primarily experimental but also including some analysis of both the phase locked and FM regions of operation. The experimental measurements were performed with an argon ion laser. Dissert. Abstr.

N68-36762# Sandia Corp., Albuquerque, N. Mex.
G-B-60A LIGHT DETECTING AND RANGING SYSTEM (LIDAR)
Murphy J. Landry Dec. 1967 41 p refs Sponsored by AEC
(SC-DR-67-115) CFSTI: HC $3.00/MF $0.65

A laser light detecting and ranging (LIDAR) system was developed primarily for use in tracking clouds formed by the ablation of radioactive materials ejected from a SNAP device during atmospheric reentry. The GB-60A, a first generation LIDAR system which has been used to observe thin atmospheric clouds, retro reflectors, balloons, and discontinuities in the atmosphere, is described. The range equations, system parameters, design details, and operation techniques associated with the system are described. Author (NSA)

N68-36886# Westinghouse Research Labs., Pittsburgh, Pa.
PLASMA PRODUCTION BY A HIGH POWER Q-SWITCHED LASER Quarterly Progress Report, 1 Aug.-31 Oct. 1967
A. G. Engelhardt 1 Nov. 1967 22 p refs
(Contract AT(30-1)-3472)
(WERL-3472-8; QPR-3) CFSTI: HC $3.00/MF $0.65

During this period the operation of the pedestal system has been improved by the insertion of apparatus which monitors the retraction velocity, and prevents the laser from being triggered while the pedestal is in the fire position. Microwave, fast-camera, and energy absorption studies were made in the absence of a magnetic field. The targets have been single isolated aluminum spheres ranging from 40 to 150 μ in radius. Theoretical studies are discussed. NSA

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-36020*# Boeing Co., Renton, Wash.
METALLOGRAPHIC AND FRACTOGRAPHIC EXAMINATION OF 7079 ALUMINUM ALLOY TEST SPECIMENS
R. R. Boyer and J. C. McMillan Sep. 1968 52 p
(Contract NAS1-6474)
(NASA-CR-66667; D6-60096) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Results are summarized of a metallographic and fractographic analysis of 7079 aluminum alloy test specimens. The examination was conducted as a function of specimen thickness and material heat treatment. The microstructural details and distribution of intermetallic particles were typical of wrought-7000-series aluminum alloys and were uniform through the thickness except for the thickest (0.630-inch) material tested. In this case, incomplete recrystallization was observed in the center of the plate. Examination of the fractured test specimens showed that some of the apparent data anomalies could be explained in terms of the microstructural details. In particular, transverse splitting resulted in unexpectedly high-fracture-toughness values because of crack tip blunting. Changes in fatigue-crack-propagation rate as a function of test environment were often accompanied by different fractographic appearances in the underaged and peak aged condition. The tendency for transverse splitting was enhanced by underaging and by testing at low temperatures. Author

N68-36033 Oklahoma Univ., Norman.
THE RELATION BETWEEN SURFACE DAMAGE AND FILM STRENGTHENING EFFECTS
Robert Marland Johnson (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-15895

The strengthening effects produced by various metallic coatings on copper single crystals were studied. There was no relation between the magnitude of the strengthening produced and the mechanical strength of the various coatings. On this basis, a mechanism involving the operation of the coating as a simple barrier to dislocation egress from the crystal was considered inappropriate. Likewise, there was no relation between the relative sheer moduli of coating and substrate and the strengthening produced. Thus, the elastic repulsion of dislocations from the coating-substrate interface was also considered to be unimportant as a mechanism. None of the results suggested that the suppression of surface Frank-Read sources made an important contribution to the strengthening effect. Dissert. Abstr.

N68-36049 California Univ., Berkeley.
THE HIGH TEMPERATURE PHASE EQUILIBRIA IN THE LEAD TITANATE-LEAD ZIRCONATE SYSTEM
Ronald Leslie Moon (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-121

Phase relationships at elevated temperatures in the lead titanate-lead zirconate system were investigated by vapor loss, X-ray, thermal, and differential thermal analyses. A solid solution is shown to exist in the region between the Curie and solidus temperatures. Experiments in the solid solution region conducted in vacuum at 1050°C and 1100°C show that vaporization of lead oxide results in the formation of a depletion layer deficient in lead

oxide. The lowest temperature at which liquid is formed in this system is the melting point of lead titanate, determined to be 1286° ±3°C. Increasing the lead zirconate to lead titanate ratio increases the solidus temperature. The highest temperature, the melting point of lead zirconate, could not be determined because of rapid crucible attack by the sample above 1500°C. At 1360°C a peritectic reaction occurs for compositions between 15 and approximately 40 mole % $PbZrO_3$. Above the peritectic temperature is a three phase region with liquid, zirconia, and lead zirconate titanate solid solution in equilibrium. Compositions richer in $PbZrO_3$ than 40 mole % decompose directly to three phases at the solidus temperatures. The existence of the three phase region demonstrates that the lead titanate-lead zirconate system is not a true binary, but a subsection of the $PbO–TiO_2–ZrO_2$ ternary system. Dissert. Abstr.

N68-36076*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CAVITATION DAMAGE OF STAINLESS STEEL, NICKEL, AND AN ALUMINUM ALLOY IN WATER FOR ASTM ROUND ROBIN TESTS
Stanley G. Young Washington Oct. 1968 20 p refs
(NASA-TM-X-1670) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Cavitation damage was determined for AISI type 316-stainless steel, nickel 270, and 6061-T6 aluminum as part of an ASTM round robin test program. A vibratory apparatus was used and tests were conducted in water at 75°F under 1 atmosphere pressure. Volume loss, volume loss rate, and mean depth of penetration were determined, and metallographic studies were made of the damage specimens. Author

N68-36205# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
EFFECT OF HELIUM GAS BUBBLES ON THE CREEP DUCTILITY OF AN AUSTENITIC ALLOY
D. A. Woodford, J. P. Smith, and J. Moteff 20 May 1968 22 p refs Presented at the Am. Society for Metals Seminar, Schenectady, N. Y.
(Contract AT(40-1)-2847)
(GEMP-607; CONF-680432-1) CFSTI: HC $3.00/MF $0.65

Post-irradiation transmission electron microscopy has been performed on a split heat of a high temperature precipitation-hardened alloy (A-286) containing 0.001 wt % and 0.010 wt % natural boron. After annealing at 760, 845, and 955°C, foils were prepared from sections taken from close to the fracture of specimens creep tested to failure. The observations were compared with those previously obtained for undeformed specimens. Helium gas bubbles were found to be arranged in spherical shells around coarse precipitates believed to be TiN. Any effect of creep deformation on bubble size was masked by the annealing treatment, and the bubble size distribution did not differ systematically from that observed for the undeformed specimens. The measured increase in creep resistance with increasing helium atom concentration is explained in terms of a reduction of dislocation mobility. It is suggested that the reduced ductility and associated reduction in strain rate sensitivity after irradiation may be very sensitive to the gas bubble distribution. The observation of bubbles on dislocations lying in the boundaries may be particularly significant. Author (NSA)

N68-36237# Technische Hochschule Hannover (West Germany).
INVESTIGATION OF THE STRUCTURE, THE FORMATION, AND THE ADHESIVE STRENGTH OF SCALING AT TEMPERATURES UP TO 1200°C AND HEATING IN DIFFERENT OXIDATION ATMOSPHERES [UNTERSUCHUNG UEBER DIE STRUKTUR, DIE BILDUNG, UND DIE HAFTFESTIGKEIT VON ZUNDER BEI TEMPERATUREN BIS 1200°C UND WAERMUNG IN VERSHIEDENEN VERBRENNUNGSATMOSPHAEREN]
Hannes Schulze Horn (Ph.D. Thesis) 1967 105 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Scale formation and structure were studied to obtain information on the differences in adhesive strength of scale on steel. A dependence was observed between scale structure and formation and the ratio of CO_2/CO and H_2O/H_2 and O_2 in the contents of the gas combustion atmospheres. The elements of the alloys were traced during the oxidation process, and new data were obtained on the diffusion of chromium, manganeses, and sulfur. Scale formation was also studied in oil combustion atmospheres. Kinetically it was noted that the scaling process is parabolic at 800°C; at 1000°and 1200°C, scaling initially occurs randomly but soon turns parabolic again. A method for indirect measurement of adhesive strength of scale between 800° to 1200°C was established, since extreme plasticity of the scale prevents direct measurement at those temperatures. Transl. by K.W.

N68-36286*# Little (Arthur D.), Inc., Cambridge, Mass.
INVESTIGATION OF THE NATURE OF STRUCTURAL CHANGE IN 2014-T6 ALUMINUM ALLOY FROM MAGNETOMOTIVE VS. CONVENTIONAL METALWORKING Monthly Progress Report, 1 Sep. 1967–1 Apr. 1968
1 Apr. 1968 59 p
(Contract NAS8-21254)
(NASA-CR-61984; MPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effect of deformation on the strengths of welded and sheet 2014-T6 aluminum has been measured. Deformation of the sheet aluminum was by magnetomotive and by explosive forming in an open die. Notched and unnotched tensile tests were performed at three temperatures, ambient, liquid nitrogen, and 350°F. Our tests showed no apparent differences in the strengths of the alloy deformed either magnetomotively or explosively, but a definite decrease in notch tensile strength for the worked sheet vs. the non-worked sheet. The welded plate or sheet was magnetomotively bulge formed, and also was hammered with the magnetomotive coil. Preliminary results of the strength tests on specimens cut from these plates and sheets are reported here and possible future work on welded plates is described. Author

N68-36288*# Stanford Univ., Calif. Dept. of Materials Science.
THE EFFECT OF MICROSTRUCTURE ON THE CLEAVAGE STRENGTH OF QUENCHED AND TEMPERED STEELS
A. S. Tetelman [1968] 20 p refs
(Grant NsG-622)
(NASA-CR-97127; SU-DMS-68-R-102) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A series of carbon-manganese steels, containing 0.18 to 0.81% carbon and 0 to 1.5% manganese were austenitized, quenched, and tempered. These compositions and heat treatments allowed a variation of maximum carbide size from 0.2 to 5 microns and a variation of free interparticle spacing from 0.13 to 3.0 microns. Standard Charpy V-notch specimens were fractured in slow three point bending over a range of temperatures from −196C to −75C where fracture occurred by cleavage. Companion tensile tests were conducted over the same temperature range to determine the effect of microstructure on the tensile yield strength. The critical tensile stress required to cause cleavage fracture below the notch root was computed by elastic-plastic analyses. Obtained values varied from 159 to 370 ksi as the microstructure was refined. The data indicate that critical fracture in fine microstructures is determined primarily by the free interparticle spacing. Author

N68-36300# Technische Hochschule Hannover (West Germany).
MEASUREMENT OF SURFACE ROUGHNESS WITH A PROFILE CALIPER: SAMPLE STUDIES ON STEEL ROD

SURFACES [DIE MESSUNG DER OBERFLAECHENRAUHEIT MIT TASTSCHNITTGERAETEN: UNTERSUCHUNGEN AM BEISPIEL DER STABSTAHLOBERFLAECHEN]

Klaus Springmann (Ph.D. Thesis) 1967 175 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

The basic process subject of this study is the measurement of surface roughness by means of caliper instruments with diamant points, profile recorders, normed profiles for evaluation, and evaluation by computers. Characteristics of instruments and methods and their effects on the accuracy of surface roughness measurements are examined in detail, and limitations of existing instruments are pointed out. Variously finished steel rod surfaces were examined to determine the most economical methods for obtaining statistically correct measurements. Transl. by K.W.

N68-36320*# Aztec School of Languages, Inc., Acton, Mass.
STRUCTURAL FACTORS RESPONSIBLE FOR THE SELECTIVITY OF THE ADSORPTION MECHANISM PRODUCING A LOSS OF STRENGTH IN METALS [O STRUKTURNYKH FAKTORAKH, OBUSLOVLIVAYUSHCHIKH IZBIRATEL'NOST' EFFEKTA ADSORBTSIONNOGO PONIZHENIYA PROCHNOSTI]

V. M. Zalkin Washington NASA Oct. 1968 5 p refs Transl. into ENGLISH from Fiz.-Khim.-Mekhan. Materialov (Ukrainian SSR), v. 4, no. 1, 1968 p 27-29
(Contract NASw-1692)
(NASA-TT-F-11968) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The general conditions necessary for the adsorption mechanism (frequently responsible for a loss of strength in steels and other metals) to become operative are presented and discussed in the light of the most recent advances in the theory of strength. Special attention is paid to structural factors arising as a result of adsorption phenomena, the physical and chemical relationship between the test material and the medium, the crystallographic characteristics of surface compounds, and stress and strain relationships in the lattice. Author

N68-36323*# Aztec School of Languages, Inc., Acton, Mass.
STRUCTURE AND GROWTH OF THIN SURFACE FILMS ON METAL THROUGH OXIDATION IN AIR

A. Steinheil Washington NASA Oct. 1968 15 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 19, no. 5, 1934 p 465-583
(Contract NASw-1692)
(NASA-TT-F-11905) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Surface oxide films like those that form on aluminum and tin in air are diagnosed for their mechanical, chemical, and crystalline properties and growth processes. From electron diffraction patterns, the film on aluminum is described as anhydrous ϵ-Al_2O_3, a face-centered cubic modification whose lattice constant is 5.35 Å, with occasional individual crystallites of hexagonal δ-Al_2O_3 detected by their plane lattice diffraction. The film on tin consists of varying mixtures of the stannic and stannous oxides. The growth processes are interpreted through the hypothesis of "repeatable steps". Author

N68-36389# Technische Hochschule Munchen (West Germany).
RESIDUAL STRESS TESTING BY MEANS OF ELECTRICAL STRAIN GAUGE STRIPS ON CASE HARDENED ROLLS OF STEEL 18 NiCrMo 14 [EIGENSPANNUNGS-UNTERSUCHUNGEN MITTELS ELEKTRISCHER DEHNUNGSMESSSTREIFEN AN EINSATZGEHAERTETEN ROLLEN DES STAHLS 18 NiCrMo]

Eckhard Tiemann (Ph.D. Thesis) 28 Mar. 1968 126 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Residual stress caused by the combined action of thermal and phase transformation processes during quenching are measured in hardened steel rolls by electrical strain gauge strips positioned inside metal cores. Accurate volumetric changes in longitude as well as diagonal directions are obtained by correlating stress-strain-time relations during carbonization of the outer metal layer. It is shown that residual stress values are influenced by the carbon distribution and thus decrease from surface to core. Transl. by G.G.

N68-36411# Naval Research Lab., Washington, D. C.
THE GROWTH OF OXIDE FILMS IN HIGH-TEMPERATURE AQUEOUS ENVIRONMENT. PART 1: GROWTH CHARACTERISTICS OF IRON OXIDE FILMS GENERATED IN DILUTE LITHIUM HYDROXIDE SOLUTION AT 300° C Final Report

John B. Moore, Jr., and Robert L. Jones 19 Jun. 1968 21 p refs
(NRL-6724; AD-673401)

In the early stages of iron oxide growth on mild steel in pH 11 LiOH solution at 300C, the oxide is largely oriented and grows at a rate and with a morphology dependent on the substrate grain orientation. After a certain film thickness is attained, however, the epitaxial oxide degenerates, leaving in its place a much thinner, fine-grained, randomly oriented base film partially covered by large solution-grown Fe_3O_4 crystals. Experimental evidence indicates that the transformation is induced by stress generated within the epitaxial oxide as the film thickens. The two-phased oxide structure which exists after completion of the epitaxial oxide degeneration persists through oxidation periods of at least 300 hours. Observations of its growth behavior lead to the postulation of a growth mechanism in which iron passes through the base film into solution, subsequently to precipitate forming the upper surface crystals. It is possible, using this hypothesis, to derive a theoretical rate law, which predicts that, in agreement with the experimentally determined corrosion rate data, the corrosion rate should decrease in a logarithmic fashion. Author (TAB)

N68-36456# Illinois Univ., Urbana. Mining, Metallurgy and Petroleum Engineering Dept.
THE EFFECT OF STRESSES ON SOLID STATE PHASE TRANSFORMATIONS Final Report, 10 Nov. 1964-31 Aug. 1968

Carl J. Altstetter 2 Sep. 1968 7 p refs
(Contract DA-31-124-ARO(D)-297)
(AROD-4953-4-MC; AD-673301))

The objective of this research was to gain a better understanding of the factors which control the occurrence and characteristics of martensitic transformations. A very simple transformation was chosen—face-centered cubic to hexagonal close packed—because it offered the best opportunity to understand the mechanism. The shears which take place may be attributed to the passage of Shockley partial dislocations over every other close-packed plane. There is a well-developed body of knowledge about the movement of dislocations under stress, to effect slip and twinning. It was hoped that the effect of stress on the martensitic transformation could be interpreted in terms of what is known about slip and twinning. Transformation in cobalt, and cobalt-nickel single and polycrystals was carried out under a series of applied stresses. Transformations in cerium and lanthanum polycrystals were studied by x-ray diffraction, dilatometry and metallographic techniques. Author (TAB)

N68-36529# Aerospace Corp., El Segundo, Calif. Lab. Operations.
FLOW AND FRACTURE OF MOLYBDENUM UNDER SPACE VACUUMS

Seymour Feuerstein Jun. 1968 30 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-20)-7; SAMSO-TR-68-237; AD-673349)

A model is postulated that accounts for the low-pressure-dependent ductility effect in bulk polycrystalline molybdenum deformed in tension at ambient temperature; a hydrogen type of emformed in tension at ambient temperature; a hydrogen type of embrittlement mechanism is proposed. This model is based on experimental data. The vacuum dependence of specimen ductility is related to the rate of gaseous monolayer coverage and subsequent surface diffusion of mobile atoms onto available atomic sites. This occupation of free atomic sites, in turn, impedes the release (also by diffusion) of contaminant gases from within the material and results in large internal pressures at crack sites at or near the surface. Author (TAB)

N68-36539# Aeronautical Research Labs., Melbourne (Australia).
THERMAL FATIGUE TESTING OF CHROMIUM ALLOY GUIDE VANES
G. G. Holt May 1968 12 p refs
(ARL/ME-295) CFSTI: HC $3.00/MF $0.65

Results of previous tests indicate that chromium alloy "J" (97.5% Cr., 2% Ta., 0.5% Si.) guide vanes will give a reasonable service life at a steady metal temperature of 1100°C. Although nitrogen contamination is evident, the contamination rate is not considered high enough to seriously impair the life of a guide vane made from this alloy. Thermal fatigue tests have been carried out to determine the behavior of contaminated and new guide vane specimens under thermal cycling, on a rig specially designed for the purpose. The thermal fatigue behavior of chromium alloy "J" when subjected to alternate hot and cold gas streams producing vane metal temperatures of 1100°C and 30°C respectively for 1000 cycles is reported. The results are compared with the performance of a similar Nimonic 115 guide vane which was tested for 400 cycles, under the same conditions. Author

N68-36598# California Univ., Livermore. Lawrence Radiation Lab.
STUDY OF THE KINETICS OF AGING OF MOLYBDENUM-BASED ALLOYS
V. P. Gol'tsev Nov. 1967 7 p refs Transl. into ENGLISH Dokl. Akad. Nauk Belorussk. SSR, no. 10, 1966 p 385-387
(UCRL-TRANS-10162) CFSTI: HC $3.00/MF $0.65

The kinetics of the dispersion hardening of Mo alloys and the nature and structure of phase separation were investigated by changes in hardening and in the lattice parameters. The nature and structure of the hardening phase was studied by X-ray phase analysis of the anodic precipitates of the alloys and from microdiffraction electronograms taken on adhering particles of the second phase. It was found that Mo-based alloys belong to the dispersion hardening alloys, the hardening phase consists mainly of the oxides of the alloying elements. NSA

N68-36647# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF NEW METHODS OF REMELTING AND OF ARGON PURGING ON THE PROPERTIES OF EP-65 STAINLESS STEEL [VLIYANIYE NOVYKH METODOV VYPLAVKI I PRODUVKI ARGONOM NA SVOISTVA NERZHAVEYUSHCHEI STACI MARKI EP-65]
P. I. Melikhov and A. V. Stepanov 30 Aug. 1967 12 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), v. 8, no. 9, 1965 p 80-85
(FTD-HT-67-201; AD-673753)

EP-65 steel is used to fabricate high-load-bearing elements that withstand temperatures of up to 500C, and its melting involves the formation of a large amount of gases and nonmetallic occlusions which cause hairline cracks and other defects in the products and reduce the mechanical properties of the steel. In this connection, the authors investigated the effect of new production techniques -- vacuum induction melting, electroslag melting and argon degassing -- on the quality of this steel. Argon degassing was carried out by bubbling argon through a ladle of 500 kg capacity, via a porous refractory plug at ladle bottom, for 2-3 min; the plug was designed by the authors. The steel from the induction furnaces and after argon degassing was cast into ingots weighing 50 and 100 kg. The 50-kg ingots were used to prepare specimens and the 100-kg ingots, as consumable electrodes for remelting in a vacuum induction furnace, or in an ANF-6 electroslag furnace. Author (TAB)

N68-36651*# Stanford Research Inst., Menlo Park, Calif. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TREATMENT OF METAL SURFACES FOR USE WITH SPACE STORABLE PROPELLANTS: A CRITICAL SURVEY
R. F. Muraca, J. S. Whittick, and J. A. Neff 15 Aug. 1968 65 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951581; SRI Proj. PRD-6063)
(NASA-CR-97062; SRI-951581-8) CFSTI: HC $3.00/MF $0.65
CSCL 11F

The survey reviews processes for treatments (passivation) of metallic surfaces that are to come into contact with the space storable propellants OF_2, ClF_3, FLOX, CH_4, and B_2H_6. It is suggested that special treatment of metals that are to come into contact with oxidizers is not necessary as long as their surfaces are free of contaminants. In practice, however, preliminary exposure of metal surfaces to any of the fluorine oxidizers is recommended to ensure deactivation of contaminants which have resisted cleaning processes. Details of a general procedure are given for pre-treatment of metal systems to be used with OF_2, ClF_3, and FLOX: (1) descale, degrease, dry, and (2) deactivate residual contaminants with a controlled fluorination treatment. The recommended fluorination treatment is merely a step in the cleaning procedure and not a deliberate attempt to provide passivation. A detailed discussion of the formation and nature of protective fluoride films is included. Available reports on the compatibilities and corrosion rates of metals and fluorine oxidizers are reviewed; guidelines for treatment of metal systems for use with methane and diborane are presented. Author

N68-36739# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Engineering Materials Lab.
APPARATUS FOR STRESS-CORROSION TESTS IN BOILING MAGNESIUM CHLORIDE SOLUTIONS
M. A. Streicher and A. J. Sweet [1968] 23 p refs

The time to failure in stress corrosion tests on stainless steels and related alloys depends on the temperature of the boiling magnesium chloride test solution. Small losses of water vapor and condensate from solutions in the range of 40 to 46 wt % $MgCl_2$ lead to rapid increases in boiling temperature. A three-part test apparatus consisting of flask, condenser, and trap, has been developed to reduce losses of water vapor and condensate to negligible proportions. With this apparatus the temperature of the boiling magnesium chloride solution can be held constant, e.g. at 155°C ± 1°C, for periods of 100 days or more. Design details are given for a 1-liter Erlenmeyer test flask, condenser, and vapor trap. In addition, dimensions are provided for two stress corrosion specimens, a U-bend and a bent-beam, together with holders for these specimens, which fit the 1-liter test apparatus. Author

N68-36831# Oklahoma Univ. Research Inst., Norman.
THE EFFECTS OF SURFACE COATINGS ON THE PLASTIC DEFORMATION OF METAL SINGLE CRYSTALS Progress Report, 15 May 1967-15 Feb. 1968
Robert Jay Block 15 Feb. 1968 72 p refs
(Contract AT(40-1)-3401)
(ORO-3401-3) CFSTI: HC $3.00/MF $0.65

The strengthening effects produced by various metallic coatings on copper single crystals were studied. There was no relation

between the magnitude of the strengthening produced and the mechanical strength of the various coatings. On this basis, a mechanism involving the operation of the coating as a simple barrier to dislocation egress from the crystal was considered inappropriate. Likewise, there was no relation between the relative shear moduli of coating and substrate and the strengthening produced. Thus, the elastic repulsion of dislocations from the coating-substrate interface was also considered to be unimportant as a mechanism. Significant film strengthening effects were always accompanied by cracking of the coating either prior to or during deformation. An increase in dislocation density at the substrate surface was associated with film cracking. This surface damage which resulted from residual stresses in the coating is believed to be an important factor in producing the film strengthening effects which were observed. Author (NSA)

N68-36837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METASTABLE PHASES IN ALLOYS OF TITANIUM, THE MECHANISM AND KINETICS OF THEIR FORMATION [METASTABILNYE FAZY V SPLAVAKH TITANA, MEKHANIZM I KINETIKA IKH OBRAZOVANIYA]

S. G. Fedotov 13 Oct. 1967 50 p refs Transl. into ENGLISH from Issled. Met. V Zhidkom i Tverdom Sostoyaniyakh. AN. SSSR (Moscow), 1964 p 207–240

(FTD-MT-24-194-67; AD-673407)

A short review is given with 56 references followed by the authors expts. for detg. Youngs and shear moduli, as well as Poisson coeffs. in quenched and annealed alloys of the following systems: Ti-Mo, Ti-V, Ti-Nb, Ti-Mo-V, Ti-V-Nb, and Ti-Mo-V-Nb. Elastic properties of alpha-Ti are twice those of beta-Ti. With annealed specimens the alloying ingredients lowered elastic properties of alpha-Ti, the more lowered were the elastic properties of the resp. alloys; the alloying elements can be put in the following order of decreasing effect on the elastic properties of Ti alloys: Mo-V-Nb. With quenched specimens and alpha-Ti or alpha + beta Ti, the alloying ingredients lowered initially the elastic properties sharply and afterwards restored their level jumpwise or even increased the level to a new max. value. Afterwards there was again a drop, followed by a slow increase. One-phase beta-Ti alloys did not show any difference in behavior of annealed and quenched specimens. Mechanisms and kinetics of martensitic beta - alpha transformation is discussed and described as taking place in 2 stages: (1) spontaneous dislocation of sep. Ti atoms into a new mech. more stable position (caused by lessened elastic stability of the initial beta-lattice); (2) either another jumpwise dislocation of Ti atoms or equilibration of dislocation forces with the rigidity of the metal at low temps. (300-500). Author (TAB)

N68-36840# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

IN-REACTOR CORROSION OF ZIRCONIUM ALLOYS

A. B. Johnson, Jr. 29 Jan. 1968 11 p refs Presented at the Ind. Meeting on Water Reactor Fuel Elem. Technol., Germantown, Md.

(Contract AT(45-1)-1830)

(BNWL-SA-1611; CONF-680105-4) CFSTI: HC $3.00/MF $0.65

A series of in-reactor experiments was run to determine the influence of variables such as coolant composition, alloy composition, and pretreatment procedures, on the flux-induced corrosion of zirconium alloys. Six zirconium alloys were tested in the ETR G-7 loop operated with pH-10 LiOH and with pH-10 NH_4OH. Specimens were either as-etched or prefilmed. The results showed that all three variables are significant, and that the response of the different alloys to in-flux corrosion is complicated. Niobium appeared to increase resistance to in-flux corrosion in the alloys tested. NSA

N68-36851# California Univ., Berkeley. Lawrence Radiation Lab.

MICROSTRUCTURE AND PLANE STRAIN FRACTURE TOUGHNESS OF HIGH STRENGTH ALUMINUM ALLOYS

Peter John Guest (M.S. Thesis) Oct. 1967 57 p refs

(Contract W-7405-eng-48)

(UCRL-17872) CFSTI: HC $3.00/MF $0.65

The plane-strain fracture toughness of precipitation hardening high strength 7075-aluminum alloy has been determined in the fully precipitation hardened condition (38 ksi-$\sqrt{in}$) and compared with the overaged and underaged conditions at predetermined stress levels less than the yield strength. Plane-strain fracture toughness values were determined using the "pop-in" technique employing single edge notched large and small type specimens. The results show that the plane-strain fracture toughness was markedly improved for both underaged (61 ksi-$\sqrt{in}$) and overaged conditions (47 ksi-$\sqrt{in}$) accompanied by a corresponding minimal loss in yield strength. The underaged condition exhibited higher toughness than the overaged condition at equivalent yield strength levels. The work required to cause crack propagation was found to increase considerably for underaging and overaging, with a larger increase for the underaged condition, over the fully precipitation-hardened condition. The plane-strain fracture toughness was found to increase with increasing strain hardening exponent. Author (NSA)

N68-36859# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

IN-REACTOR CREEP OF ZIRCONIUM ALLOYS

E. R. Gilbert and A. L. Bement 18 Jan. 1968 14 p Presented at the Ind. Meeting on Water Reactor Fuel Element Technol., Germantown, Md.

(Contract AT(45-1)-1830)

(BNWL-SA-1598; CONF-680105-3) CFSTI: HC $3.00/MF $0.65

In-reactor creep tests on two zirconium alloys, Zircaloy-2 and Zr-2.5 Nb, were conducted to determine the effect of concurrent irradiation on creep at different stresses and temperatures. The design of the creep test capsule is described, and the tests results are presented. The Zr-2.5 Nb offers an advantage in lower creep rates at high stress levels greater than 21 kg/mm^2 (30,000 psi). At lower stress levels both alloys have approximately the same in-reactor creep rates. NSA

N68-36864# Oak Ridge National Lab., Tenn.

PLASTIC DEFORMATION OF COBALT SINGLE CRYSTALS

A. Seeger, H. Kronmueller, O. Boser, and M. Rapp [1968] 28 p refs Transl. into ENGLISH from Phys. Stat. Sol., no. 3, 1963 p 1107–1125

(ORNL-TR-1823) CFSTI: HC $3.00/MF $0.65

Cobalt single crystals were plastically deformed in tension at various temperatures. The ductility of the crystals remained good even at low temperatures. The work-hardening curves and the electron microscopy slip line patterns are qualitatively similar to those of other hexagonal metals and may be similarly interpreted. Besides plastic shear on the basal plane, $|11\bar{2}2|$ and $|11\bar{2}4|$ twin planes are observed for the investigated crystal orientations. The geometry of this so-called anomalous twin formation is discussed. Author (NSA)

N68-36866# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

AN APPLICATION OF THE THEORY OF PARTICLE COARSENING: THE γ' PRECIPITATE IN Ni–Al ALLOYS

A. J. Ardell Aug. 1967 19 p refs

(Contract AT(04-3)-221)

(CALT-221-34) CFSTI: HC $3.00/MF $0.65

Coarsening of the γ' precipitate in binary Ni–Al alloys containing 6.35 and 6.50 wt. % Al has been studied by measuring

the ferromagnetic Curie temperature as a function of aging time at 625° and 715°C. The concentration of Al is linearly related to $t^{-1/3}$ at long aging times, in agreement with theory. Analysis of the kinetics has provided values of c_e, the concentration of Al in equilibrium with a γ' particle of infinite size. The values of c_e are about 10% larger than the literature values of the solubility at the relevant temperatures. This suggests that the present values of c_e represent the coherent solubilities. The results are used to exemplify a method for obtaining reliable values of the particle-matrix interfacial free energy, γ, and the effective diffusivity of the solute in the matrix, D_{eff}. As a result of the proposed method, the value of γ has been revised to approximately 14 erg/cm^2 from a previous estimate of 30 erg/cm^2. The value of D_{eff} is greater than the (extrapolated) coefficient of diffusion of Al in very dilute Ni by a factor of about two. The D_{eff} is also a factor of two greater than that predicted by the application of irreversible thermodynamics to the process of volume-constrained growth and ungrowth of coherent precipitates during coarsening.
Author (NSA)

N68-36917# Royal Aircraft Establishment, Farnborough (England).
THE SHEET RESISTANCE AND STRUCTURE OF TITANIUM-OXYGEN AND TITANIUM-NITROGEN FILMS MADE BY REACTIVE EVAPORATION
J. Harvey Jan. 1968 26 p refs
(RAE-TR-68012) CFSTI: HC $3.00/MF $0.65

Thin films of titanium containing oxygen or nitrogen have been prepared and studied in an attempt to produce an improved film resistor material having high sheet resistance with an acceptable temperature coefficient of resistance and stability. It is shown that the maximum useful sheet resistance obtainable with Ti-O or Ti-N films, made by reactive evaporation, is about 1000 ohms/square. This offers some improvement over materials currently used (e.g. Nichrome, $< \approx 300$ ohms/square) but it seems unlikely that this is sufficient to justify the use of titanium for resistors unless TiO_2 were also being used as the dielectric for capacitors.
Author (ESRO)

N68-36919# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF ENVIRONMENT ON FATIGUE CRACK PROPAGATION. MEASUREMENT ON ALUMINUM ALLOYS AT DIFFERENT FREQUENCIES
F. J. Bradshaw and C. Wheeler Feb. 1968 23 p refs
(RAE-TR-68041) CFSTI: HC $3.00/MF $0.65

Measurements of crack growth at fatigue frequencies of 6000, 60 and 1 cpm in various environments show that frequency effects in crack propagation can be partly (for an AlZnMg alloy) or all (for an AlCuMg alloy) due to environment. The observed effects of oxygen and water vapor are interpreted on the basis of gas adsorption at the crack tip. The combined action of these gases in ordinary air is considered and some predictions are made for crack growth at other fatigue frequencies. Author (ESRO)

N68-36926# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SOLID STATE DIFFUSION IN ZIRCONIUM-COPPER AND ZIRCONIUM-NICKEL SYSTEMS. STUDY OF THE INTERMETALLIC COMPOUNDS FORMED [DIFFUSION A L'ETAT SOLIDE DANS LES SYSTEMES ZIRCONIUM-CUIVRE ET ZIRCONIUM-NICKEL. ETUDE DES COMPOSES INTERMETALLIQUES FORMES]
Lucienne Meny and Michel Champigny May 1968 24 p refs In FRENCH; ENGLISH summary Presented at the 1st Natl. Am. Congr. on Microanalysis by Electronic Probe, Washington, May 1968
(CEA-R-3517) CFSTI: HC $3.00/MF $0.65

Solid state diffusion has been provoked in pure Zr-Cu and Zr-Ni metal couples. The tests were carried out in the following experimental conditions: the samples were maintained at a mechanical pressure of 30 kg/cm^2; annealing was carried out in a secondary vacuum during 100 and 500 hours, at temperatures of between 650° and 900°C. In all cases, a diffusion zone made up of several parallel layers was formed. The various intermetallic compounds have been studied by metallography (optical microscopy and micro-hardness) X-ray diffraction and micro-analysis with an electronic probe. In the Zr-Cu system, six compounds have been determined, Zr_2Cu, ZrCu, Zr_2Cu_3, $ZrCu_4$ and $ZrCu_5$. These results confirm a recent publication mentioning for the first time the existence of $ZrCu_5$ and demonstrating the formulae $ZrCu_3$ and $ZrCu_4$. In a similar manner, six compounds have been found stable at room temperature, in the Zr–Ni system: Zr_2Ni, ZrNi, Zr_7Ni_{10}, $ZrNi_3$, $ZrNi_4$ and $ZrNi_5$; the the results of American workers are confirmed for four of these compounds; however the compounds for which they proposed the formulae Zr_2Ni_5 and Zr_2Ni_7 are identified as $ZrNi_3$ and $ZrNi_4$. A comparison of these results suggests that the two systems Zr-Cu and Zr–Ni have the same type of equilibrium diagrams. Author (ESRO)

N68-36938# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
THE THERMODYNAMIC APPROACH OF THE PILOT-SCALE PURIFICATION OF REFRACTORY METALS. [APPLICATION DE LA THERMODYNAMIQUE A LA MISE AU POINT DES METHODES DE PURIFICATION INDUSTRIELLE DES METAUX ET SEMI-METAUX REFRACTAIRES]
André Accary Jul. 1968 39 p refs In FRENCH; ENGLISH summary Presented at the EUCHEM Meeting on High Temp. Chem., Semmering, Austria, Oct. 1967
(CEA-R-3390) CFSTI: $3.00/MF $0.65

It is shown how the thermodynamics can be applied to the prediction of the evolution of impurities from a metal or an alloy being melted and cast at the pilot scale using electron bombardment and continuous casting in a water cooled copper. Two examples are demonstrated; the melting of vanadium and the melting of the uranium monocarbide. Using only the constants available in the literature and a few special runs in the pilot equipment itself it is possible to determine: the possibility of elimination of any one impurity by keeping the material in the melting state under vacuum as well as the limit of purification which is achievable under given technological conditions, and the proportion of an impure metal which should be vaporized in order to bring the level of a given impurity down to a predetermined level and the necessary duration of heating. Author (ESRO)

N68-36957# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
X-RAY TOPOGRAPHY OF URANIUM ALLOYS [TOPOGRAPHIE AUX RAYONS X D'ALLIAGES D'URANIUM]
Lucien Le Naour May 1968 53 p refs In FRENCH; ENGLISH summary
(CEA-R-3494) CFSTI: HC $3.00/MF $0.65

A description of the structure of uranium alloys has been made using the data obtained by X-ray diffraction techniques derived from the Berg-Barrett method. In the first stage the use of a monochromatic beam of X-rays having a very low divergence makes it possible to obtain very reproducible and exact numerical data concerning the grain and sub-grain sizes, and also the distribution of the sizes. It is thereby possible to detect any disorientation greater than 30 seconds of arc. The results obtained have been completed using a variable incidence device which gives simultaneously an overall picture of a grain and an idea of the importance of internal disorientations; a more rigorous measurement of this latter parameter is then deduced from the Debye-Sherrer diagrams obtained using a fine-focus equipment. Observations are carried out on various one-phase or two-phase uranium alloys which are compared successively to technical and to high-purity

uranium. It is shown that the use of X-ray topographies, although limited in certain respects, allows a quantitative characterization of the structure. Author (ESRO)

N68-36970*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFLUENCE OF GASEOUS ENVIRONMENT ON THE SELF-ADHESION OF METALS

William P. Gilbreath Washington Oct. 1968 21 p refs
(NASA-TN-D-4868) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The self-adhesion of metal surfaces was measured in various gases with pressure, exposure duration, and temperature as variables. Aluminum, copper, gold, lead, magnesium, and titanium were studied in air, argon, carbon monoxide, ethylene, hydrogen, nitrogen, and oxygen. The results showed that loss of adhesion for a particular metal resulted from gas adsorption on its contacting surface and that the effect of environment upon adhesion could be related to the heat of adsorption for the particular metal-gas interaction. Author

N68-37025# Aerojet-General Corp., San Ramon, Calif. Nuclear Div.

EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING Quarterly Progress Report, 1 Jan.–31 Mar. 1968

May 1968 34 p refs
(Contract AT(04-3)-368)
(AGN-8279) CFSTI: HC$3.00/MF$0.65

The characterization of the metallurgical structure and oxidation behavior of Hastelloy X aged for various durations continues. Uniaxial creep tests at 1300°F in argon were terminated after 2530 hours. A centrifugal creep testing of specimens of three heats of Hastelloy X at 1400°F in high purity argon was terminated after 2232 hours. The centrifugal creep specimens tested at 1400°F were examined metallographically to identify microstructural changes. The specimens were also digested chemically and the remaining particles identified by X-ray techniques. Differences in structure were observed between stressed specimens and statically aged specimens. Microhardness measurements were made on centrifugal creep specimens tested at 1300 and 1400°F. The activation energy in the 1725 to 1785 psi range is 60,200 cal/mole and in the 1288 to 1372 psi range is 88,948 cal/mole. NSA

N68-37053*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MECHANICAL PROPERTIES AND COLUMN BEHAVIOR OF THIN WALL BERYLLIUM TUBING

Donald R. Rummler, H. Benson Dexter, George H. Harth, III, and Raymond A. Buchanan Washington Oct. 1968 77 p refs
(NASA-TN-D-4833) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The results of an experimental investigation to determine the mechanical properties and column behavior of commercially produced beryllium tubing at room temperature are presented. The investigation included three types of extruded tubing and one type of plasma-sprayed and sintered tubing. The diameters of the tubes ranged from 0.25 to 0.75 inch (6.35 to 19.05 mm). Wall thickness was either 0.020 or 0.040 inch (0.508 or 1.016 mm). Microhardness measurements and metallurgical studies were performed to characterize the tubing microstructure. On the basis of the results of mechanical-property determinations and column tests, the extruded tubing appeared to be suitable for use in truss-type structures. Column buckling loads could be predicted satisfactorily by using the tangent modulus, derived from compressive stress–strain curves, in the inelastic column-buckling equation. The results also indicated that the reproducibility of the dimensions and the mechanical properties of the extruded beryllium tubing were comparable to that of other aircraft structural materials. Author

N68-37098# Oak Ridge National Lab., Tenn.

CORRELATION OF COMPOSITION AND HEAT-TREATMENT WITH THE MICROSTRUCTURES OF URANIUM CARBIDES

Mildred Bradley Sears, Robert J. Gray, Leslie M. Ferris, and B. C. Leslie Jul. 1968 115 p refs
(Contract W-7405-ENG-26)
(ORNL-3515) CFSTI: HC$3.00/MF$0.65

Optical photomicrographs, at magnifications of 250× and 1000×, of 78 different arc-cast and heat-treated uranium carbide specimens are presented. Specimens with total-C/U atom ratios ranging from 0.4 to 2.4 (2 to 11 wt % carbon) are included; however, the major emphasis is on the monocarbide-dicarbide, monocarbide-sesquicarbide, and sesquicarbide-dicarbide regions of the phase diagram. The phases present were identified by X-ray diffraction analysis of the specimens at room temperature and, in many instances, were further confirmed by determining the products of hydrolysis. The specimens were analyzed for uranium, total carbon, free carbon, oxygen, nitrogen, and tungsten to provide as complete a characterization as possible. Author (NSA)

N68-37097# Oak Ridge National Lab., Tenn.

THE EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF SINGLE CRYSTALS OF IRON WITH DIFFERENT CARBON CONTENT. 1. THE YIELD STRESS AT THE BEGINNING OF DEFORMATION

G. P. Seidel 1968 16 p refs Transl. into ENGLISH from Phys. Status Solidi (Frankfurt), v. 25, 1968 p 175–188
(ORNL-TR-1932) CFSTI: HC$3.00/MF$0.65

An investigation was made of the mechanism of radiation hardening for iron single crystals with small amounts of carbon (20 and $\leq$8 ppM by weight). The dependence of the yield stress on the irradiation dose and the deformation temperature was measured and annealing experiments were performed. The radiation-induced increase of the yield stress is strongly dependent on the carbon content, saturates completely at a rather low dose (3×10^{17} n/cm^2) and recovers only above 230°C. The temperature dependence of the yield stress can be described by the interaction between the dislocation and defects with tetragonal symmetry. The results are interpreted in terms of dislocation obstacles which are produced by neutron irradiation and which consist of complexes of carbon atoms and vacancies or interstitials. Author (NSA)

N68-37127# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

DILATOMETRIC, RADIOCRYSTALLOGRAPHIC AND MICROSTRUCTURAL STUDY OF TRANSFORMATIONS PRODUCED BY QUENCHING AT DIFFERENT RATES WITH SUBSEQUENT TEMPERING, IN ZIRCONIUM-COPPER ALLOYS CONTAINING LESS THAN 5 PER CENT COPPER BY WEIGHT [ETUDE DILATOMETRIQUE, RADIOCRISTALLOGRAPHIQUE ET MICROSTRUCTURALE DES TRANSFORMATIONS PAR TREMPE A DIVERSES VITESSES ET PAR REVENU ULTERIEUR DES ALLIAGES ZIRCONIUM-CUIVRE A FAIBLES TENEURS (INFERIEURES A 5 POUR CENT POIDS)]

Annick Couterne (Ph.D. Thesis) Mar. 1968 128 p refs In FRENCH; ENGLISH summary
(CEA-R-3448) CFSTI: HC$3.00/MF$0.65

When β-phase zirconium-copper alloys are strongly tempered, transformations occur leading to metastable phases which are not predicted by the equilibrium diagram. The formation mechanism is always of the martensitic type but the crystalline structures are very different according to the amount of the added element. When the copper content is about 1 percent by weight, a hexagonal α' phase is obtained having parameters which are very close to those of the α solid solution; its morphology is strongly acicular. When

the copper content is equal or greater than 1.6 per cent Cu by weight, a new ω phase has been shown to exist. This phase has a hexagonal symmetry (c/a = 0.624) and the crystals formed are of sub-microscopic size. This ω phase is decomposed on isothermal or anisothermal tempering, probably by shearing, at a temperature which is practically below 550°C; an α super saturated solid solution is first formed and there then occurs a gradual change to the α equilibrium solid solution with progressive precipitation of the compound Zr_2Cu. Author (ESRO)

N68-37153*# International Harvester Co., Chicago, Ill.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein Jul. 1968 24 p refs
(Contract NAS7-469)
(NASA-CR-97276; RDR-1534-8) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The contribution of solutes to the creep strength of columbium and tantalum base alloys is being studied through their effect on the activation energy for creep. In this regard, a comparison of creep data for columbium and D43 suggests that the solid solution strengtheners contribute much more to the creep strength of D43 near $0.5T_M$ than does the carbide dispersion. The activation energy and the stress dependence of the creep rate for D43 were determined over a range of temperatures and stresses. The activation energy, H, between 1600 and 3300°F is given by the equation H = 0.034 (2300–T) + 110 where T is the temperature in °F and H is the K cal/mole. The stress dependence of the creep rate (ϵ^*) over this temperature range can be expressed by the proportionality, $\epsilon^* \alpha e^{B\sigma}$ where B is a constant and σ is the stress. Author

N68-37189# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTICS AND EXAMPLES FOR APPLICATION OF HEAT-RESISTANT CASTING ALLOY [EIGENSCHAFTEN UND ANWENDUNGSBEISPIELE DER WARMFESTEN GUSSLEGIERUNG 2361]
J. Sternkopf and W. Fricke 26 Sep. 1967 20 p refs Transl. into ENGLISH from Neue Huette (Leipzig), no. 2, 1965 p 108–114
(FTD-HT-67-314; AD-673406)

The strength characteristics at various temperatures of a casting alloy in the production of a small gas turbine were investigated. The high-temperature characteristics, on the basis of the test results described, were of high quality and compared favorably with alloys made abroad. The turbine parts made from this alloy were briefly described. Author (TAB)

N68-37203*# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF CARBIDES
Graham E. Hollox May 1968 64 p refs
(Contracts NASw-1290; DA-31-124-ARO-D-467)
(NASA-CR-97265; TR-3; TR-7; RIAS-TR-68-10C) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The need for improved materials in high temperature structural applications has stimulated research into the mechanical behavior of a number of materials including the refractory hard metals. The transition metal carbides are of particular interest for a number of reasons, for example: (a) these compounds include the materials having the highest melting points, (b) they are extremely strong, and (c) they deform plastically in a manner similar to FCC metals. The purpose of this paper is to review the present understanding—or lack of it—of the deformation process and the factors affecting the mechanical behavior of these technologically important materials, consequently the more intepretable information obtained in recent years from studies of single crystals, rather than that from sintered polycrystalline materials, is emphasized. Author (TAB)

N68-37336# Lockheed-California Co., Burbank.
FRACTURE TOUGHNESS AND CRACK PROPAGATION OF 300 M STEEL
S. L. Pendleberry, R. F. Simenz, and E. K. Walker Washington FAA Aug. 1968 258 p refs
(Contract FA-67-WA-1821)
(DS-68-18)

Fracture toughness and crack propagation behavior was investigated for 300 M steel in sheet, plate and forging products. The variables included material thickness and material strength levels. Both surface-crack and through-crack specimens were evaluated in moist air and salt water spray environments for cyclic stress ratios of +0.1, +0.2, and +0.5. Variation in fracture toughness with heat chemistry was found to be relatively large with respect to that resulting from other metallurgical variables. Significant geometric variables included variations in fracture toughness with a/t ratio and variation of cracking rate with thickness. Several approaches to MIL-HDBK-5 type presentation of crack growth data are discussed. A crack growth index based on a standard stress intensity is suggested, and log-log and log-linear forms of stress intensity vs. cracking rate are presented and discussed. Other techniques are curves of constant cracking rate plotted on stress vs. crack length coordinate and a modification of Goodman Diagrams to depict cracking rates in a presentation form which included the stress ratio variable. Author

N68-37405*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATERIALS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 91–93 refs (See N68-37397 23-11)

Presented are preliminary results of studies on the effect of sharp notches on the strength of cross-rolled beryllium ingot and powder sheet. Studies were undertaken to determine whether material other than hot pressed block would show any notch strengthening at $K_t < 5$, and what the effects of different K_t (stress concentration factor), process history, and composition had on the transition from strengthening to weakening of beryllium. Samples tested were double-edge-notched sheet tensile specimen 0.025 in. thick, 1/4 in. wide, with a 3/4-in. gauge length. Results suggest that the presence of sharp notches in Be sheet need not cause catastrophic failure. Ingot sheet was weakened in the transverse direction, but was not weakened significantly in the longitudinal direction. It is surmised that although it would be misleading to suggest that rolled Be sheet is not notched sensitive, in structures which use thin gauges of Be, there appeared to be more tolerance for defects than anticipated. S.C.W.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-36060 Missouri Univ., Rolla.
COMPRESSIVE CREEP OF HIGH ALUMINA REFRACTORIES
Vernon Lee Burdick (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-16737

The deformation of refractory materials consisting of 90% sintered or fused alumina plus 10% silica was measured at

temperatures from 1450° to 1515°C and a compressive stress of 100 psi. Creep rates and activation energies were determined from the steady state portion of deformation vs. time data and correlated with the mineralogical composition. Supplemental measurements included X-ray diffraction, electron probe microanalysis, apparent porosity and tensile strength. Conditions having an important effect upon the mineralogical composition were: (1) duration of heat treatment; (2) amount of sodium oxide impurity; and (3) reactivity of the alumina grain. Prolonged heat treatment and sodium oxide impurity enhanced mullite formation, thus lowering creep rates. The activation energies ranged from 75 kcal/mole for samples containing sintered alumina doped with 0.5% sodium oxide, to 140–150 kcal/mole for regular sintered or fused alumina. The magnitude of the activation energy was approximately proportional to the mullite content. Dissert. Abstr.

N68-36080*# Los Alamos Scientific Lab., N. Mex.
CMF-13 RESEARCH ON CARBON AND GRAPHITE Summary Progress Report, 1 May–31 Jul. 1968
Morton C. Smith 4 Sep. 1968 34 p Sponsored in part by NASA (Contract W-7405-eng-36)
(NASA-CR-97144; LA-3989-MS; Rept.-6) CFSTI: HC $3.00/MF $0.65 CSCL 11B

Summarized are studies and characterizations of natural, commercial, and experimental carbons and graphites based on X-ray diffraction, electron and optical microscopy, and porosimetry. Physical and mechanical properties of these materials are measured as functions of formulation, treatment, and environmental variables. Raw materials and manufacturing techniques are investigated, improved, and varied systematically to create specific internal structures believed to be responsible for desirable combinations of properties. Data and graphs are included which present findings on specific carbons and graphites. D.H.B.

N68-36147 Rensselaer Polytechnic Inst., Troy, N. Y.
CREEP OF POLYSULFIDE RUBBER UNDER NONSTEADY ATMOSPHERIC TEMPERATURES AND LOADS
Reginald Lipscomb Amory (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-811

The polysulfide elastomers exhibit the properties of instantaneous deformation, delayed elasticity, and flow when undergoing nonsteady creep. The mechanism of nonsteady creep is investigated for atmospheric temperatures. Expressions are included that show the amount of deformation a polysulfide rubber would attain, had this material undergone a simultaneous change of load and temperature during a steady-state creep experiment. Polysulfide elastomers containing various amounts of plasticizer and filler are subjected to steady-state creep, stress relaxation, and modulus of elasticity experiments. These experiments provide the necessary viscoelastic parameters required to describe nonsteady creep. The time-temperature shift relationship, which is dependent upon the glass transition temperature of the polysulfide polymer, is used to describe the equivalent viscosity of the nonsteady state creep four element analogous model used in this investigation. Dissert. Abstr.

N68-36154# General Precision Systems, Inc., Little Falls, N. J. Aerospace Research Center.
STUDY OF MICROMECHANICAL PROPERTIES OF ADHESIVE-BONDED JOINTS Final Report, 30 Jun. 1967–29 Jun. 1968
Edward J. Hughes and John L. Rutherford Dover, N. J. Picatinny Arsenal Aug. 1968 76 p refs
(Contract DAAA21-67-C-0500)
(PA-TR-3744; AD-673745)

The basic purpose of this program was to demonstrate the feasibility and utility of making microstrain measurements to establish the mechanical properties of adhesives in metal-metal bonds. Loading modes were tension, compression and shear as a function of joint thickness and test temperature for selected adhesive systems. A high sensitivity capacitance-type extensometer was used to measure the deformation. The following accomplishments were achieved: (1) Tensile mechanical properties of epoxy adhesives in bulk form are different from the epoxy in a metal bonded joint. (2) The tensile modulus increases with: decreasing thickness, increasing strain rate, lower test temperature, higher modulus adherends. (3) The shear modulus increases with decreasing test temperature, increasing strain rate and is independent of thickness in the range of 0.004 to 0.040 inches. (4) The precision elastic limit and the viscoelastic behavior are affected by composition, test temperature and stress level. (5) Several systems showed work hardening. These techniques and results have provided new insights into the deformation characteristics of epoxy adhesives in metal bonded joints. Author (TAB)

N68-36347# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES TO THE STRUCTURE OF IONIC SOLIDS Quarterly Report, 1 Mar.–31 May 1968
K. Vedam and R. E. Newnham Watertown, Mass. Army Mater. and Mech. Res. Center 20 Jun. 1968 29 p refs
(Contract DA-19-066-AMC-325(X))
(AMMRC-CR-66-07/8; QR-8; AD-673835)

Experiments to cement the thin mica flakes to various materials for making reproducible microhardness measurements on them, were not successful. Hence, a suitable jig has been designed to hold the thin flakes firmly to the base, and is currently under fabrication. From an analysis of the crystal structures of the various micas two equations were obtained which can be used to predict the tetrahedral rotation angles alpha and the differences (Delta) between the outer and inner interlayer cation-oxygen distances from chemical composition data only. It was found that Delta is a linear function of alpha which is predominantly controlled by the tetrahedral-octahedral sheet misfit. Finally, it is suggested that barium restricts the formation of random stacking faults in much the same way as basal plane corrugation in dioctahedral micas. Author (TAB)

N68-36369# Joint Publications Research Service, New York.
DEVELOPMENTS IN PLASTICS
18 Sep. 1968 14 p Transl. into ENGLISH from Plasticheskiye Massy (Moscow), no. 7, 1968 p 27–28, 47–48
(JPRS-46453) CFSTI: HC $3.00/MF $0.65

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1. NEW HEAT-RESISTANT FERROMAGNETIC PLASTICS L. V. Pevzner, K. N. Haryakina, O. A. Ivanova, Z. A. Lytayeva, and L. I. Kopayeva p 1–5 refs (See N68-36370 23-18)
2. GLASS-FIBER PLASTIC LAMINATE ON POLY (FURFURYLIDENE-AMINOPROPYL) SILOXANE BASE L. M. Prutkov, I. K. Sanin, I. V. Kamenskiy, and N. S. Zabel'nikov p 6–9 refs (See N68-36371 23-18)

N68-36370# Joint Publications Research Service, New York.
NEW HEAT-RESISTANT FERROMAGNETIC PLASTICS
L. V. Pevzner, K. N. Haryakina, O. S. Ivanova, Z. A. Lytayeva, and L. I. Kopayeva *In its* Develop. in Plastics 18 Sep. 1968 p 1–5 refs (See N68-36369 23-18)

Production and properties are described for a heat-resistant ferromagnetic plastic, designated PM-18, which is made by the mechanical and chemical bonding of polymers with dispersed powdered iron. The PM-18 plastic displays good impact strength, flexural strength, augmented thermal and electrical conductivities, and certain magnetic properties. While a slight deformation of the

plastic specimen was observed in the 200 to 220°C range, there was no further change with heating up to 350°C. When the plastic was used for the magnetic cleats of asynchronous electric motors, motor efficiency was substantially raised. M.W.R.

N68-36371# Joint Publications Research Service, New York.
GLASS-FIBER PLASTIC LAMINATE ON POLY (FURFURYLIDENE-AMINOPROPYL) SILOXANE BASE
L. M. Prutkov, I. K. Sanin, I. V. Kamenskiy, and N. S. Zabel'nikov *In its* Develop. in Plastics 18 Sep. 1968 p 6-9 refs (See N68-36369 23-18)

The use of poly(furfurylidene-aminopropyl) siloxane (PFS) as a binder for glass-fiber plastic laminates was studied. The laminate on a PFS base possessed a high heat-distortion stability, retaining 61% of its starting resistance at 200°C and 44% at 300°C when specimens were heated for 40 minutes at each temperature. It was found to be resistant to the effects of water organic solvents and diluted alkalis, but not to acids and concentrated alkali solutions. Properties of glass-fiber laminates on the PFS base and on two other silicone resins are tabulated. M.W.R.

N68-36404# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE UNIT CELL OF BETA-TA2O5
G. M. Wolten Mar. 1968 15 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-15; SAMSO-TR-68-254; AD-673477)

Single crystals of beta-Ta2O5 were grown from molten KPO3. The lattice parameters are a = 14.65A, b = 9.395A, and c = 31.19A; the space group is Pna2. It appears that this is a different polymorph from that represented by reagent-grade powder. The morphology is described. Author (TAB)

N68-36532 Society of Plastics Engineers, Inc., New York.
POLYMER MODIFIED POLYMERS
Robert D. Forger, ed. [1968] 158 p refs Presented at the Regional Tech. Conf., New York, 21 Mar. 1968

CONTENTS:

1. VISCOELASTIC ADHESIVES FOR VIBRATION DAMPING METAL LAMINATE APPLICATIONS A. F. Lewis and G. B. Elder (Am. Cyanamid Co.) 9 p refs (See N68-36533 23-18)

2. CHLORINATED POLYETHYLENE AND ITS USE IN FLEXIBLE POLYMER BLENDS G. H. Graham and R. B. Cramer (Dow Chem. Co.) 7 p (See N68-36534 23-18)

3. WHAT ARE THE HAZARDS OF PLASTICS—IN ACTUAL USE? M. M. Brown (Com. and Ind. Insurance Co.) 3 p (See N68-36535 23-18)

4. EFFECT OF MOLECULAR WEIGHT DISTRIBUTION ON MELT RELAXATION SPECTRA AND FLOW BEHAVIOR OF POLYSTYRENES C. G. Gogos (Stevens Inst. of Technol.) 9 p refs (See N68-36536 23-18)

5. RUBBER MODIFIED CROSSLINKED POLYMERS F. J. McGarry and J. Sultan (MIT) 147 p refs (See N68-36537 23-18)

N68-36533 American Cyanamid Co., Stamford, Conn. Plastics and Resins Div.
VISCOELASTIC ADHESIVES FOR VIBRATION DAMPING METAL LAMINATE APPLICATIONS
Armand F. Lewis and G. Brent Elder *In* Soc. of Plastics Engr., Inc., Polymer Modified Polymers [1968] 9 p refs (See N68-36532 23-18)

Parameters that affect vibration damping laminates used as structural materials were examined; and mechanical, thermal, and adhesional properties were analyzed for a tough glassy polyamide epoxy and a viscoelastic fluid of the type used in pressure sensitive tapes. Properties of these two postformable constrained layer vibration damping metal laminates were then compared with polyurethane-based adhesive systems. It was found that adhesive interlayers for such metal laminate applications must be rubbery and remain in the rubbery state with relatively uniform elastic and loss moduli throughout the temperature range. In the glassy state, laminates with the adhesive interlayers exhibit low levels of damping efficiency. While viscoelastic fluid adhesives exhibit the highest damping efficiency in controlled layer applications, their structural integrity is low. Usable temperature range of these laminates is narrow because the interlayer is subject to cold flow at moderately elevated temperatures, and even at room temperature in some cases. M.W.R.

N68-36534 Dow Chemical Co., Plaquemine, La.
CHLORINATED POLYETHYLENE AND ITS USE IN FLEXIBLE POLYMER BLENDS
Glen H. Graham and Robert B. Cramer *In* Soc. of Plastics Engr., Inc., Polymer Modified Polymers [1968] 7 p (See N68-36532 23-18)

A wide variety of polymers were found to be compatible with chlorinated polyethylene (CPE) and CPE/PVC (polyvinyl chloride) blends. For the initial study, 12 thermoplastic polymers were each evaluated with CPE and with three ratios of CPE/PVC to determine the effects of flexible blending. Although three polymer blends were found to eliminate certain deficiencies, a fourth or fifth polymer was sometimes added to obtain the desired physical properties. A 70/30 blend of CPE/PVC was found to be too stiff and its percent heat distortion was too high for a particular application; the addition of 10% ethylene ethyl acrylate significantly decreased stiffness and low temperature brittleness, but increased the percent heat distortion. The addition of acrylonitrile-butadiene-styrene lowered heat distortion without affecting the other properties. The addition of 1 to 3% polymethyl methacrylate further lowered per cent heat distortion, improved processing, and resulted in only a slight increase in stiffness. Four or five polymer blends were successfully fabricated into sheet materials. M.W.R.

N68-36535 Commerce and Industry Insurance Co., New York.
WHAT ARE THE HAZARDS OF PLASTICS IN ACTUAL USE?
Martin M. Brown *In* Soc. of Plastics Engr., Inc. Polymer Modified Polymers [1968] 3 p (See N68-36532 23-18)

Fire hazards of plastics in current use are discussed in terms of relative safety, industrial requirements, and flammability and burning rates. It is noted that improved testing procedures have resulted in the re-evaluation and consequent relisting of the hazards involved in the use of plastics. Various listings for classifying the burning rates of commercial plastics are noted. M.W.R.

N68-36536 Stevens Inst. of Tech., Hoboken, N. J.
EFFECT OF MOLECULAR WEIGHT DISTRIBUTION ON MELT RELAXATION SPECTRA AND FLOW BEHAVIOR OF POLYSTYRENES
Costas G. Gogos *In* Soc. of Plastics Engr., Inc. Polymer Modified Polymers [1968] 9 p refs (See N68-36532 23-18)

Well characterized polystyrene samples were investigated for their shear rate dependent viscosity and melt stress relaxation behavior; and viscosity behavior was explained qualitatively in terms of the last portion of their samples' discrete spectrum. With an increase in polydispersity, at constant molecular weight, the maximum relaxation time increased; and the melt became non-Newtonian at a lower shear rate. There was a wide spacing of relaxation times in the flow region, which lowered the rate of decrease of viscosity at low shear rates of polydisperse polymers. The dispersion index was not found to be a unique measure of molecular weight distribution. M.W.R.

N68-36537 Massachusetts Inst. of Tech., Cambridge. Civil Engineering Dept.
RUBBER MODIFIED CROSSLINKED POLYMERS
Frederick J. McGarry and Jacques Sultan *In* Soc. of Plastics Engr., Inc. Polymer Modified Polymers [1968] 147 p refs (See N68-36532 23-18)

By introducing into a polyester prepolymer a low concentration of an elastomer having reactive sites such as carboxyl-terminated butadiene-acronlonitrite copolymer (Hycar CTBN), fracture toughness of the resultant polyester can be increased by a factor of 8 to 11 because of the local cold flow in the material. Attempts to modify other polyester resins with elastomers such as butadiene-styrene copolymer were not as successful. Compounding GRS-1006 with a polyester containing 81 to 83 pph styrene led to material that was highly crack resistant, with surface toughness increased 50 to 100 times as compared to a 50/50 alkyd/styrene resin formulation. Crack resistance was also improved by reinforcement with 181-glass fabric, and there was good retention of stiffness properties of a composite under cyclic tensile stresses when 5 to 7.5 pph Hycar CTBN was introduced in the matrix. Other additions were not as successful. Details are included for the studies on crack propagation resistance of rubber modified polyester resins and the fatigue cracking resistance of the 181-glass cloth laminated rubber modified polyester. M.W.R.

N68-36636 National Aerospace Lab., Tokyo (Japan).
THE MEASUREMENT OF THERMAL PROPERTIES OF REINFORCED PLASTICS AT TEMPERATURES UP TO 150°C (INFRARED RADIATION METHOD)
Koichi Ogawa and Yoshio Noguchi 1968 26 p refs
(NAL-TR-150) CFSTI: $3.00

This paper presents the technique of measuring thermal properties, such as thermal diffusivity, heat capacity and thermal conductivity of reinforced plastics, and particularly the characteristics of those materials at temperatures up to 150°C using the infra-red radiation method. Eighteen different reinforced plastics were tested, these materials consisting of phenol, epoxy, polyester, silicon, flan and melamine for the resin material, and glass, Tetoron, asbestos, nylon, cotton cloth and paper for the reinforcing material, respectively. From the results of measurement of thermal properties of reinforced plastics at temperatures up to 150°C, the following conclusions are deduced: (1) thermal diffusivity α decreases as the temperature rises and its value is more affected by the reinforcing material than that of the resin; (2) heat capacity ρc increases as the temperature rises and the effect does not depend so much on the reinforcing and resin materials; and (3) these plastics have different characteristics as to thermal conductivity κ, depending upon the material, the influence of the reinforcing material predominating over that of the resin. Author

N68-36640# Maryland Univ., College Park. Dept. of Chemical Engineering.
REVIEW OF DIFFUSION IN POLYMER PENETRANT SYSTEMS
Theodore G. Smith Sep. 1968 231 p refs
(Grant NGR-20-002-053)
(NASA-CR-97218) CFSTI: $3.00 CSCL 11I

An overview is presented on the models, mechanisms, and laws relating solubility, permeability, and diffusivity in polymer diluent systems with the characteristics and molecular properties of the components. Main emphasis is placed on the transport of relatively low molecular weight gases, vapors, and liquids (penetrants) in polymer solids with the restriction that the concentration of the sorbed species is small relative to the amount of polymer solid present. Comprehensive tables of diffusion data are given, but are not correlated. Basic definitions and general equation are reviewed from the literature for the diffusion, solubility, and permeation coefficients; diffusion mechanism; the experimental determination of diffusion; concentration, pressure, and temperature dependence of coefficients; the nature of the penetrant and polymer; and non-Fickian behavior. A bibliography is included. B.P.

N68-36650# Sandia Corp., Albuquerque, N. Mex. Measurements Development Div. 2.
SANDIA THICK QUARTZ GAGE QUALITY TESTING AND APPLICATION NOTES
R. E. Hutchison and T. B. Morse Oct. 1967 48 p refs
(Contract AT(29-1)-789)
(SC-TM-67-807) CFSTI: HC $3.00/MF $0.65

A detailed explanation of shock tube testing as a nondestructive dynamic check on Sandia thick quartz quality is presented. A low-amplitude plane stress is applied over the entire front electrode area and the gage output current terminated in a low impedance at the recording oscilloscope. The test simulates operational conditions with a simple step input allowing abnormal perturbations in the detected stress-time profile, indicative of internal gage faults, to be quickly noticed. Information is provided on material sample bonding, bond tests, and general applications. Several appendices are included which describe the usual inspection procedure and a number of other gage quality tests which have been employed with varying degrees of success. Author (NSA)

N68-36655*# IIT Research Inst., Chicago, Ill.
TEXTILE TECHNOLOGY FROM AEROSPACE RESEARCH
Miles A. Greenbaum and W. John Wheeler 9 Jun. 1967 34 p refs
(NASA-CR-97195) CFSTI: HC $3.00/MF $0.65 CSCL 11E

This paper presents a general review of government generated technology to illustrate their relevance to the textile and apparel industries. The applicable technology touched on a variety of areas concerned with fibers and fabrics; these include new products, thermal resistance, physical testing methods and manufacturing techniques. Many of these topics were not originally conceived as being applicable to commercial textile operations, but appear to have considerable potential for inter-industry transfer. An attempt has been made to select those items which may be of interest to textile management as well as to the technologist. These items should be viewed as samples of available relevant technology, not as an exhausted survey of the field. In addition, a bibliography is included to give a more comprehensive list of pertinent articles which are available from government publications. Author

N68-36660*# Kentucky Univ., Lexington. Dept. of Metallurgical Engineering.
INTERACTION OF CRACKS WITH MICROSTRUCTURE IN POLYCRYSTALLINE CERAMICS Semiannual Progress Report
Martin H. Leipold 31 Oct. 1968 12 p refs
(Grant NGR-18-001-038)
(NASA-CR-97204) CFSTI: HC $3.00/MF $0.65 CSCL 11B

A program was undertaken to develop a technique for simultaneously monitoring the stresses and the detailed path produced by a crack proceeding through a polycrystalline ceramic. Two approaches were employed in developing a technique that permitted controlled propagation of a crack; the first used differential thermal expansion between a reference body and a piece of polycrystalline ceramic, the second used the strains developed in a piezoelectric crystal under an applied electric field. Piezoelectric elements were used in transducers for quantitative stress monitoring during propagation in order to provide an output proportional to the shear on the crystal faces. Initial evaluation of the technique on commercial ceramics was made and the role of impurities was studied using five samples of polycrystalline MgO. Attempts made to extend the technique of crack monitoring to the electron microscope, emphasizing reflection methods, were not successful. M.W.R.

N68-36733# General Electric Co., St. Petersburg, Fla. Pinellas Pinsula Plant.
MOLD RELEASE CAPABILITY OF "TEFLON" FILMS FUSED ONTO METALLIC MOLDS
D. I. Holton 10 Oct. 1967 10 p
(Contract AT(29-2)-656)
(GEPP-9; R-67ND6) CFSTI: HC $3.00/MF $0.65

Teflon film applied as a fused coating to metal molds and gluing fixtures, can act as a release medium without adhering to an epoxy resin surface such as Hysol 13-009. This mold release capability of Teflon is useful when contamination of a resin surface cannot be tolerated. Teflon and Ram 225 (Silicone) are compared as release agents. They are about equal in terms of the force required to separate a mold from its resin casting. Teflon is superior in its resin casting cleanliness, but its film is susceptible to mechanical damage. Considering these qualities, Teflon can be useful material, but its application must be chosen with care.
Author (NSA)

N68-36798# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTIFRICTION PROPERTIES OF BORON NITRIDE DURING DRY FRICTION IN GASEOUS MEDIA AND AT LOW TEMPERATURES [ANTIFRIKTSIONNYE SVOISTVA NITRIDA BORA PRI SUKHOM TRENNI V GAZOVYKH SREDAKH I PRI NIZKIKH TEMPERATURAKH]
V. F. Afanasev Oct. 1967 10 p Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 7, 1966 p 49-52
(FTD-HT-67-348; AD-673802)

The friction behavior of five series of boron nitride disks was studied under conditions of dry friction against nitrided 1Kh18N9T steel at 300, 273, 195 and 77K in air at a pressure of 133.322 n/sq m and in argon, helium, and nitrogen at 300K. The series differed from one another by the density of the specimens. Temperature was found to have a pronounced effect on the friction coefficient and wear resistance. With decreasing temperature the friction coefficient increased from 0.17-0.19 at 300K to 0.32-0.34 at 79K, and the weight loss increased from 20-21 g at 300K to 30-32 g at 77K in a two-hour test. With increasing specific pressure the weight loss increased first fairly slowly and then sharply when a certain critical pressure had been reached. At specific pressures below critical a shiny film was formed on the specimens surface. However, at pressures above critical the film broke down. In gaseous media, friction coefficient and wear depend on the linear speed. This dependence is especially strong in nitrogen, argon, and helium, in which the respective friction coefficients increase from 0.30, 0.30, and 0.28 at a speed of 0.5 m/sec to 3.20, 3.50, and 2.80 at a speed of 10.5 m/sec. The specimen temperature in tests in air did not exceed 523K compared to 573-623K observed in tests in other gases.
Author (TAB)

N68-36830*# Rensselaer Polytechnic Inst., Troy, N. Y.
MATERIALS RESEARCH Semiannual Progress Report, 1 Mar.-31 Aug. 1968
Sep. 1968 66 p
(Grants NGL 33-018-003; NsG 100-60)
(NASA-CR-97202) CSCL 11

Brief technical descriptions are presented for research begun, in progress, or completed in the general categories of structural characterization and synthesis of materials, solid state reactions and phase transformations, mechanical properties and strengthening mechanisms, electronic and physical properties of materials, and environment sensitive behavior. The role of hydrogen sulfide as a reagent for initiating vinyl polymerization, the mechanism of deposition of pyrolytic graphite, and the kinetics of polymerization of methyl methacrylate at high conversion were studied. The kinetics were defined of cellular precipitation in nickel base alloys and of the martensite transformation. Studies on dispersion strengthened alloys, hardness of glass, rheology of liquid polymers, mechanical behavior of amorphous polymers, fiber formation, and properties of composites are summarized. Ultrasonic velocities were measured in a variety of substances in order to determine the elastic constants of the materials. Corrosion studies of composite materials such as fiber reinforced metals, cemented carbides, and austenitic stainless steels are being carried out to determine the influence of microstructural variables in the solids, and chemical composition of the solutions.
B.P.

N68-36910*# General Precision Systems, Inc., Little Falls, N. J. Kearfott Group.
HIGH TEMPERATURE EPOXYCARBORANE ADHESIVES Final Report
Robert Barnes and Edward Hughes 9 Jun. 1968 70 p refs
(Contract NAS9-7001)
(NASA-CR-92327) CFSTI: HC $3.00/MF $0.65 CSCL 11A

High temperature bond properties are demonstrated for bis(epoxybutyl)-carborane cured with a polyfunctional aromatic amine hardener. Lap-shear strengths greater than 1700 psi at 500°F in air have been obtained with steel on steel (joints). Specimens soaked at 500°F in air for 24 hours gave lap-shear strengths of almost 1500 psi at 500°F. These results were obtained on systems which were not optimized regarding the ratio of reactants and were not modified by fillers, plasticizers or antioxidants. These systems may reasonably be expected to undergo further improvement in elevated temperature bond strength. Tests with other carborane derivatives did not give as good high temperature strengths.
Author

N68-36962# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROSCOPY STUDIES OF GRAPHITIZATION
E. M. Woodruff 17 Jun. 1968 7 p Presented at the 18th Ann. Meeting on Carbonization and Graphitization, Paris
(Contract AT(45-1)-1830)
(BNWL-SA-1903) CFSTI: HC $3.00/MF $0.65

A subgranular structure has been identified in graphites representing a broad range of morphological characteristics. Subgrains have been defined as lamellar features bounded on basal sides by slip zones and at the edges by tilt boundaries. Subgrains may be distinguished from crystallites by size and by the continuous nature of their boundaries. Basal subgrain boundaries begin to develop during calcining or baking while edge boundaries do not appear until polygonization occurs at about 2700°C. Modifications of subgrain structures are introduced at low temperatures by stresses and inclusions and at high temperatures by external stress and interactions with metals. Internal stresses apparently cause a reduction of subgrain thicknesses above 3000°C by the creation of new slip zones. Studies of granular forms of graphite have been extended to include new variations found in graphite crystallized from the liquid phase.
Author (NSA)

N68-37022# Du Pont de Nemours (E. I.) and Co., Wilmington, Del.
X-RAY EMISSION MEASUREMENT OF CHEMICAL PENETRATION INTO REINFORCED PLASTICS
Richard F. Regester and William M. Riggs [1968] 16 p refs

The depth of chemical penetration into a reinforced plastic structure exposed to aggressive environments can be determined by the X-ray emission spectroscopy method described. The method involves successive removal of layers from a sample, followed each time by X-ray emission measurement of the concentration of the penetrating chemical element on the newly exposed surface.

Analysis of small size samples taken from panels used in standard long term exposure tests can provide useful information on structural integrity. The method can also be used to measure the degree of attack on structures already in service, if a small section can be removed during shutdown. Author

N68-37026# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

RADIO-VULCANIZATION OF NATURAL RUBBER IN THE LATEX PHASE. STUDY OF AN EXPERIMENTAL 1 TON PER HOUR PRODUCTION [RADIO-VULCANISATION DU CAOUTCHOUC NATUREL EN PHASE LATEX ETUDE D'UNE PRODUCTION EXPERIMENTALE DE 1 TONNE PAR HEURE]

Pierre Leveque, Jean-Rene Puig, and Henri Roudeix Jan. 1968 76p refs In FRENCH
(CEA-R-3345)

After a brief review of the research carried out on the radio-vulcanization of latex and elastomers, a description is given of 4 types of cell which have been used successively with a view to industrial irradiation. They have made it possible to acquire the information necessary for resolving the main problem arising during irradiation—the formation of coagulum. The first two cells are designed for irradiation by a horizontal beam (Dynamitron), the two others use a vertical beam (Circé). The study of the properties of the rubber shows it to compare favorably with Revultex. An appendix gives some characteristics of natural latex and information about its processing. Author (NSA)

N68-37114# Royal Aircraft Establishment, Farnborough (England).

THE EFFECTS OF SIMULATED SPACE RADIATION ON SOME RUBBERS

C. J. Savage Feb. 1968 37 p refs
(RAE-TR-68042) CFSTI: HC $3.00/MF $0.65

A preliminary investigation has been made into the effects of simulated space radiation on natural and synthetic rubbers. Irradiation was performed in air at atmospheric pressure and at reduced pressure, to examine the influence of the surrounding gas on the radiation induced changes. Measurements of tensile strength, elasticity and hardness are reported. Author (ESRO)

N68-37149# Royal Aircraft Establishment, Farnborough (England).

THE WEAR OF POLYMERS AT ELEVATED TEMPERATURES AND ITS DEPENDENCE ON MECHANICAL PROPERTIES

J. K. Lancaster Feb. 1968 34 p refs
(RAE-TR-68045) CFSTI: HC $3.00/MF $0.65

The influence of some mechanical properties of polymers—hardness, elastic modulus, breaking strength and elongation to break—on their wear rates has been determined at various temperatures. Many polymers exhibit a minimum wear rate at a particular temperature. The relative proportion of plastic to elastic deformation, characterized by the ratio of hardness to elastic modulus, is almost independent of temperature for most polymers. Variations in this ratio are therefore insufficient to explain the observed changes in wear rate. In contrast, the product of the breaking strength s and the elongation to break ϵ_r is a very significant parameter. In conditions of abrasive wear, there is an approximately linear relationship between the room temperature values of $1/s\,\epsilon_r$ for a large number of polymers and their wear rates. In steady state sliding conditions, however, this relationship no longer applies because of the complicating effects of transfer of polymer to the counterface. Author (ESRO)

N68-37188# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDYING OXIDE CERAMICS BY THE HIGH TEMPERATURE ROENTGENOGRAPHY METHOD [ISSLEDOVANIE OKISNOI KERAMIKI METODOM VYSOKOTEMPERATURNOI RENTGENOFRAFII]

V. N. Strekalovskii, A. F. Bessonov, V. M. Ustyantsev, and G. V. Burov 20 Sep. 1967 16 p. refs Transl. into ENGLISH from Akad. SSSR. Ural'skiy Filial. Inst. Elektron. Trudy, no. 006, 1965 p 123–130
(FTD-HT-23-688-67; AD-673393)

A description is given of high-temperature attachments for x-ray diffraction studies with photo- and ionization recording of the diffraction pattern (at temperatures between 20 and 1500C). Examples of high-temperature x-ray analyses are given for sintered oxide materials: CeO2, CeO2-SrO, ZrO2-Y2O3, ZrO2-Nd2O3, ZrO2-CaO. The transitions occurring in ZrO2-Nd2O3 and ZrO2-Y2O3 on heating and cooling are determined. The x-ray coefficients of thermal expansion of these samples are found to be lower than the dilatometric ones. It is postulated that the difference in the change of the lattice constant of CeO2 as studied in air and vacuum is due to the formation of a solid solution of Ce2O3 in a vacuum. Author (TAB)

N68-37249# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Engineering Technology Lab.

DEFORMATION OF POLYETHYLENE TEREPHTHALATE

Henry O. Foster and David E. Hook [1968] 32 p refs

The deformation of many crystalline polymers can be described by simple but nonlinear viscoelastic models. A model for the tensile deformation of polyethylene terephthalate polymer is described herein, and the extreme sensitivity of the material to heat generation during deformation is discussed. Experiments were devised for measuring the temperature rise during deformation, and the analytical model was used to reduce the data. The results show that more heat is generated than can be accounted for by the viscous dissipation of energy. This leads to the conclusion that strain-induced crystallization is a major source of heat generation in polyethylene terephthalate. Author

N68-37252# Technological Lab. RVO-TNO, Rijswijk (Netherlands).

SHOCK RESISTANCE OF VARIOUS LIGHWEIGHT STRUCTURES (BUOYANCE BLOCKS) FOR INCREASING THE BUOYANCY OF M 113 VEHICLES [DE SCHOKVASTHEID VAN DIVERSE LICHTE CONSTRUCTIES (DRIJFLICHAMEN) BESTEMD VOOR VERHOGING VAN HET DRIJFJVERMOGEN VAN M 133 VOERTUIGEN]

E. W. Lindeijer and R. U. Jongenburger 9 May 1968 10 p In DUTCH
(TL-1968-8) CFSTI: HC $3.00/MF $0.65

In an effort to increase the buoyancy of the amphibious M 113 vehicle, the use of buoyant blocks affixed to the Al armor plate of the vehicle is considered. Tests were conducted to determine the strength of the buoyant blocks in case of explosions, particularly underwater mine explosions. The feasibility of using blocks made of polyurethane foam and balsa wood was evaluated. The blocks were coated with a polyester laminate and bonded to the 1 1/8-in. Al armor plate. The tests were performed with the specimens submerged in a water basin and subjected to explosions of 1 kg of TNT at distances of 3 m or 2 m; this corresponds to military specifications, which call for resistance to damage in case of a 9-kg TNT explosion at distances of 9 m or 6 m. Balsa wood blocks were found to have greater resistance against damage by detonation waves. Transl. by K.W.

N68-37257# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Engineering Physics Lab.

METHODS FOR PREVENTING STATIC DAMAGE TO PHOTOGRAPHIC PAPER

John E. Owens [1968] 19 p

Static sparking in the opening nip of unwinding rolls of photographic paper can produce photographic exposure and damage

to the product. A method is discussed for determining the degree of sparking protection provided by conductive layers within a nonconductive substrate. A controlled-nip unwinding technique is described, and is shown to prevent sparking and damage. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-36016 Maryland Univ., College Park.
FINITE DIFFERENCE APPROXIMATIONS FOR EIGENVALUES OF UNIFORMLY ELLIPTIC OPERATORS
James Robert Kuttler (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-517

A general theorem is proved on the asymptotic rate of convergence of eigenvalues and eigenfunctions of finite difference approximations to the eigenvalues and eigenfunctions of uniformly elliptic operators in two and three dimensions. The theorem is used to show convergence of a particular scheme for a type of elliptic operator with non-constant coefficients and convergence for two schemes for the Laplace operator. Multiple eigenvalues are treated. A general theorem on the asymptotic rate of convergence of the solutions of finite difference approximations to the solutions of forced vibration problems for elliptic operators is also given with applications to specific schemes. Numerical examples are exhibited. Dissert. Abstr.

N68-36026 State Univ. of Iowa, Iowa City.
QUALITATIVE BEHAVIOR OF SOLUTIONS OF A THIRD ORDER NONLINEAR ORDINARY DIFFERENTIAL EQUATION
John Willard Heidel (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-16802

This dissertation investigates the qualitative behavior of nonoscillatory solutions of the differential equation (1) $y''' + p(t)y' + q(t)y^r = 0$ where p(t) and q(t) are continuous, real valued functions of a real variable in the interval (a_1, ∞) for some $0 \leq a_1 < \infty$ and r is positive and the quotient of odd integers. A nontrivial solution of (1) is said to be oscillatory if it has arbitrarily large zeros. A solution is nonoscillatory if it is continuable and not oscillatory. Some of the major results obtained are now stated. Dissert. Abstr.

N68-36034 Stanford Univ., Calif.
INFINITELY DIVISIBLE MATRICES, KERNALS, AND FUNCTIONS
Roger Alan Horn (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17440

Necessary and sufficient conditions characterizing infinitely divisible matrices and kernels are given, and it is shown that the occurrence of zero entries or values is subject to a certain graph-theoretical condition. A number of technically useful lemmata are given, after which attention is turned to applications of the theory. The first applications are to the classical trigonometric and algebraic moment problems, and a natural notion of infinitely divisible moment sequence is introduced. The structure of such sequences is determined and representation formulae are given which show that there is a close relationship between infinitely divisible moment sequences and a semigroup of analytic functions having positive real part in the unit disc or in half plane. The infinitely divisible positive definite functions and infinitely divisible completely monotonic functions are discussed. Dissert. Abstr.

N68-36035 Stanford Univ., Calif.
CONVERGENCE OF OPERATOR SEMIGROUPS WITH APPLICATIONS TO MARKOV PROCESSES
Thomas Gordon Kurtz (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17450

The convergence in law of sequences of Markov processes is treated from the standpoint of the operator semigroups the processes determine on Banach spaces of functions defined on the state spaces. Using a notion of convergence of operators defined on different Branch spaces, necessary and sufficient conditions, in terms of the infinitesimal operators, are given for the convergence of both continuous parameter and discrete parameter semigroups to a continuous parameter semigroup. Examples and applications of density dependent families in biology and chemistry are described. Dissert. Abstr.

N68-36052 Washington Univ., St. Louis, Mo.
THE INDEFINITE QUADRATIC PROGRAMMING PROBLEM
Raymond Karl Mueller (Ph.D. Thesis) 1967 87 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-17172

A method is developed to determine if an indefinite quadratic form is convex, concave, or neither convex nor concave over a convex set determined by a set of linear inequalities and nonnegative variables. A quadratic programming problem is considered with an indefinite quadratic form as objective function, linear constraints, and nonnegative variables. If the optimal vector is not an extreme point, it lies on a boundary at a stationary point of the quadratic form restricted to the boundary. The quadratic form must be negative semidefinite on the boundary for the stationary point to be an optimal solution. Since the quadratic form may be negative semidefinite on many boundaries and all extreme points must be examined, this is not an efficient procedure to find the optimum. A heuristic is developed to solve problems efficiently. Fifty-seven test problems were used to test the heuristic and 55 of the 57 test problems were solved exactly, while two test problems were within one percent of the solution. Dissert. Abstr.

N68-36126 Arizona Univ., Tucson.
TOPOLOGIES FOR PROBABILISTIC METRIC SPACES
Richard Thomas Fritsche (Ph.D. Thesis) 1967 48 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-16507

Given a one-place function, ϕ, on $[0, \infty]$, a generalized topology may be defined on any probabilistic metric space (S, F), and this generalized topology is equivalent to one obtained on S from a non-negative, non-decreasing ϕ, called a profile function. Neighborhoods in these generalized topologies possess several desirable properties and the distance function F is lower semi-continuous under certain restrictions. If $F_{pq} - \phi$ is non-decreasing for each distance-distribution function F_{pq}, the generalized topology is a topology in the usual sense and, in certain special cases, further neighborhood properties and a metrization theorem are established. Given an arbitrary subset X of the positive quadrant and a probabilistic metric space (S, F) a profile function can be found whose generalized topology on S is weaker than that generated by X, but is equivalent to it if X is, e.g., open. This latter result is best-possible in the sense that, if any other profile function greater than this one is chosen, a probabilistic metric space with a weaker X-topology can be found. Dissert. Abstr.

N68-36135 Michigan Univ., Ann Arbor.
ON EMBEDDING AND IMMERSING MANIFOLDS IN EUCLIDEAN SPACE
Henry Hatfield Glover (Ph.D. Thesis) 1967 49 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17763

The main result is the theorem: If a closed k-connected smooth n-manifold immerses in euclidean (2n–2k-1)-space, $0 \leq k \leq (n-3)/4$, then it embeds in euclidean (2n–2k)-space. The major ingredient in the proof of this result is the theorem which classifies smooth embeddings by means of equivariant (not necessarily smooth) maps. In addition, proofs are given that generalize work on the existence and classification of smooth embeddings in Euclidean space, and on the classification of smooth immersions of an n-manifold in Euclidean 2n-space. Dissert. Abstr.

N68-36152#
ON A METHOD OF SOLVING SYSTEMS OF NONLINEAR ALGEBRAIC AND TRANSCENDENTAL EQUATIONS
M. D. Maergoiz [1968] 5 p Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 4, 1967 p 869–874
CFSTI: HC $3.00/MF $0.65

A generalization of an iterative method is given for the solution of systems of nonlinear algebraic and transcendental equations, which is considered more convenient for practical application. The quadratic convergence of the proposed iterative process is proved under compliance with definite conditions. Author

N68-36196# Defense Documentation Center, Alexandria, Va.
SELECTED TOPICS IN NONLINEAR DIFFERENTIAL EQUATIONS, VOLUME 1 Bibliography
Jul. 1968 145 p refs Presented at the Conf. on Qualitative Theory for Differential and Integral Equations, Madison, Wis.
(DDC-TAS-68-20, V. 1; AD-673800)

This Unclassified-Unlimited bibliography was compiled for distribution to the Academic Conference on Qualitative Theory for Differential and Integral Equations at Madison, Wisconsin. This bibliography is compiled in accession number (AD-number) sequence only and has two sets of indexes a Personal Author and a Corporate Author Index. It contains 118 references. Author (TAB)

N68-36215 Wisconsin Univ., Madison.
NUMERICAL METHODS AND EXISTENCE THEOREMS FOR SINGULAR LINEAR BOUNDARY-VALUE PROBLEMS
Pierre Jamet (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-10636

Numerical methods are studied for self-adjoint and non self-adjoint singular boundary value problems in one and two dimensions. The uniform convergence of the approximations and the existence of the solution are proven at the same time. Uniqueness properties may require a separate argument. In the one-dimensional case, more specific results are given concerning monotonicity of convergence, comparison of the self-adjoint and the non self-adjoint schemes, error analysis; also, a problem involving finite difference equations which are not of positive type is studied. Dissert. Abstr.

N68-36238 California Univ., Berkeley.
SINGULAR PERTURBATION OF A LINEAR PARTIAL DIFFERENTIAL EQUATION WITH CONSTANT COEFFICIENTS
Hussain Sayid Nur (Ph.D. Thesis) 1967 30 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-126

This dissertation is concerned with showing the convergence of certain solutions of such partial differential equations as $L_\epsilon(u) = 0$ as $0 < \epsilon \to 0$, to a solution of the limit equation ($\epsilon = 0$), $L_0(u) = 0$, or in other words, with the question of stability of the solutions of the Cauchy problem with initial values on $t = 0$, as $\epsilon \to 0$. This relationship was previously discussed under the assumption of convergence of the initial data up to order l–1. In this paper a different stability is demonstrated. Dissert. Abstr.

N68-36290# Stanford Univ., Calif. Dept. of Computer Science.
THREE-STAGE VARIABLE-SHIFT ITERATION FOR POLYNOMIAL ZEROS AND ITS RELATION TO GENERALIZED RAYLEIGH ITERATION
M. S. Jenkins and J. F. Traub 26 Aug. 1968 49 p refs
(Contract N00014-67-A-0112)
(CS-107; AD-673673)

The report describes a new three-stage process for calculating the zeros of a polynomial with complex coefficients. The algorithm is similar in spirit to the two-stage algorithms studied by Traub in a series of papers. The algorithm is restriction free, that is, it converges for any distribution of zeros. A proof of global convergence is given. Author (TAB)

N68-36293# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DIRICHLET PROBLEM OF A SYSTEM OF DEGENERATING ELLIPTIC TYPE EQUATIONS
Liang-Jing Chen 19 Sep. 1967 17 p refs Transl. into ENGLISH from Shu Hsueh Hsueh Pao (Chinese People's Republic), v. 14, no. 3, 1964 p 379–386 refs
(FTD-HT-67-338; AD-673656)

The author begins by discussing two theorems previously proven by Prof. Yen Chin-ta (0917/1807/6671). The article then goes on to investigate these two theorems according to a new kernel spectrum theory. On this basis, the problem can be transformed to a problem of corresponding Lie algebra, and can be discussed as follows: If G is a three-dimensional Lie algebra, search for any one Lie algebra G and one of its true representations phi which satisfies P(G) C phi(G). The problem here is to consider G as a semisimple Lie algebra and G as a 3-dimensional simple subalgebra of G. TAB

N68-36387# California Univ., Berkeley. Operations Research Center.
A NOTE ON TESTS FOR MONOTONE FAILURE RATE BASED ON INCOMPLETE DATA
Richard E. Barlow and Frank Proschan Apr. 1968 29 p refs
(Contracts Nonr-3656(18); DA-31-124-ARO(D)-331; Grants NSF GK-1684; NSF GP-7417)
(ORC-68-7; AD-669111)

Tests for exponential versus IFRA (Increasing Failure Rate Average) distributions based on incomplete data are defined and shown to be unbiased. The tests are motivated by a class of tests considered in detail by Bickel and Doksum. Tests for exponential versus IFRA distributions based on the ranks of total time on test statistics are also considered. Author (TAB)

N68-36409# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
FACES OF AN INTEGER POLYHEDRON FOR CYCLIC GROUPS, PART 1
Fred Glover Jul. 1968 27 p refs *Its* Management Sci. Res. Rept. 135
(Contract Nonr-760(24))
(AD-673405)

Faces of a certain integer polyhedron identified by Ralph Gomory provide especially strong cuts for integer programming.

This polyhedron is the convex hull of nonnegative lattice points satisfying an equation whose coefficients are elements of an additive group. Observing mildly limiting assumptions, a procedure is given for rapidly generating large numbers of faces for polyhedra associated with cyclic groups, which constitute the preponderance of those encountered in an integer programming context. Author (TAB)

N68-36417 Stanford Univ., Calif.
LINEAR DECISION RULES WHICH MINIMIZE MAXIMUM PROBABILITY OF ERROR
Karl Arnold Belser (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-17396

This research develops a method for solving the pattern-classification problem by selecting a linear decision rule which minimizes maximum probability of error. For this problem, it is assumed that only limited statistical information can be estimated from the available sample patterns. Maximum probability of error functions are derived which apply to every possible linear decision rule for the case when only the mean vectors and the covariance matrices of the available measurements for each state of nature are known. These functions are ratios of quadratic polynomials and hence are easily evaluated. Minimax linear decision rules are derived which minimize these maximum probability of error functions. Least-mean-square (LMS) linear decision rules are also considered as a special case because of their computational simplicity. Dissert. Abstr.

N68-36448# Maryland Univ., College Park. Computer Science Center.
CONVEXITY IN GRAPHS: MATHEMATICAL PRELIMINARIES TO A THEORY OF GRAPH GRAMMARS
John L. Pfaltz Jul. 1968 103 p refs
(Contract Nonr-5144(00))
(TR-68-74; AD-673420)

A natural concept of convexity for directed graphs is introduced, and properties of the lattice of convex subgraphs of a graph are studied. The extent to which this lattice determines the graph is established, and conditions for a lattice to be a convex subgraph lattice are investigated. The concept of a lower semi-homomorphism is defined for lattices; it is shown that such mappings preserve basic properties of convex subgraph lattices, and that on such lattices, they are uniquely determined by their kernels. Graph homomorphisms which preserve convexity are also studied, with emphasis on their relationship to lower semi-homomorphisms of the convex subgraph lattice. Homomorphisms which contract subgraphs (which are analogous to the rewriting rules of context-sensitive phrase structure grammars) are briefly considered. TAB

N68-36452 Michigan Univ., Ann Arbor.
GLOBAL CONTINUOUS SOLUTIONS OF HYPERBOLIC SYSTEMS OF QUASI-LINEAR EQUATIONS
Jeffrey Lee Johnson (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17786

The two-dimensional system of quasi-linear equations in Riemann invariant form is considered, and a solution to the Cauchy problem is sought. Conditions for a global Lipschitz continuous solution of the problem are stated; this solution is unique and depends continuously on the initial data. The existence proof is outlined. It is pointed out that the theorem can be applied to the equations of one-dimensional isentropic flow in gas dynamics. Dissert. Abstr.

N68-36454 Michigan Univ., Ann Arbor.
BOUNDARY FUNCTIONS
Theodore John Kaczynski (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17790

A more direct proof is offered for the theorem which states that if f is a continuous function mapping H into the Rieman sphere, then the set of curvilinear convergence of f is of type $F_{\sigma\delta}$. Conversely, it is proved that if A is a set of type $F_{\sigma\delta}$ in X, then there exists a bounded continuous complex-valued function in H having A as its set of curvilinear convergence. It is also proved that a boundary function for a continuous function can always be made into a function of Baire class 1 by changing its values on a countable set of points. Further, proof is presented to show that a boundary function for a function of Baire class $\xi \geq 1$ in H is of Baire class at most $\xi + 1$. It follows from this that a boundary function for a Borel-measurable function is always Borel-measurable; however, a boundary function for a Lebesgue-measurable function need not be Lebesgue-measurable. Dissert. Abstr.

N68-36525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ITERATED COMMUTATORS AND FUNCTIONS OF OPERATORS
Howard C. Volkin Washington Oct. 1968 18 p refs
(NASA-TN-D-4857) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A new method is developed by which certain functions of the noncommuting operators A and B can be expressed in a systematic and efficient way in terms of successively higher commutators of the operators. The procedure is designed primarily for polynomials, exponential functions, and analytic functions of the operator (A + B). The method is related to the ordered-operator calculus of Feynman. Certain commutation properties of the operators A and B are represented by polynomials in A and B called iterated commutators. The functions are converted into equivalent forms involving the iterated commutators. All iterated commutators of degree (j + 1) in A and B are combined in a suitable sum to form a new operator $G_{(j)}$. By working only with the $G_{(j)}$ and their commutators, the calculations are simplified and the results are given in an extremely compact notation. Author

N68-36547# Basel Univ. (Switzerland). Mathematical Inst.
CONTRIBUTION TO THE THEORY OF MATRICES PARTITIONED INTO BLOCKS Final Technical Report, 1 Jun.–31 Aug. 1967; 15 Mar.–15 Jun. 1968
Alexander M. Ostrowski Jun. 1968 10 p refs
(Contract DA-91-591-EUC-3946)
(AD-673286)

New inequalities have been obtained for the inertia triple of certain partitioned matrices, using theorems on skew-triangular block (STB) matrices. Further properties of the schur complement were obtained, and applications were made to matrix inequalities and computation of eigenvalues. Several results were obtained on cones of matrices and vectors, and an extension of the well-known perron-frobenius theorem was proved. Also a necessary and sufficient condition was derived, in order that to a given matrix corresponds a cone on which it is a positive operator. Easily computed upper and lower bounds were obtained for the maximum and minimum roots of a hermitian matrix. Author (TAB)

N68-36548# Naval Research Lab., Washington, D. C.
TESTING AND MERGING OF CONFIDENCE AREAS
M. E. B. Owens and M. J. Romer 8 Aug. 1968 29 p refs
(NRL-MEMO-1911; AD-673402)

It is assumed that an entity can be described by two parameters (e.g., its position in a plane) and that the maximum

likelihood estimates of these parameters with associated fiducial probabilities constitute an estimate. Two problems are addressed: (1) what is the probability that two estimates pertain to the same entity, and (2) if the two estimates pertain to the same entity, what is the optimum new estimate and associated confidence regions. Although the first problem can not be solved in its entirety without knowledge of a priori probabilities, a conditional probability is derived under the assumption that the given estimates can be described by a bivariate normal distribution. The second problem is solved under the same assumption. Author (TAB)

N68-36631 Cornell Univ., Ithaca, N. Y.
A FUNDAMENTAL SOLUTION OF THE PARABOLIC EQUATION ON HILBERT SPACE
Margaret Ann Garrett Piech (Ph.D. Thesis) 1967 48 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-674

The differential equation $\partial/\partial t\ u(x,t) = \text{trace}\ [A(x)\cdot u''(x,t)]$ where $A(x) = I - B(x)$, $u : B \times (0,\infty) \to R^1$ and denotes the Frechet derivative with respect to x in directions of H, possesses a fundamental solution in the following sense: *Theorem* There exists a family of finite Borel measures $q_t(x,dy)$ on B such that if $q_tf(x) = \int_B f(y)\ q_t(x,dy)$ for all bounded Lip 1 functions f on B, then (i) $q_tf(x)$ is differentiable with respect to t and twice Frechet differentiable with respect to x in directions of H, (ii) $[A(x)\ (q_tf)''(x)]$ is trace class, (iii) $\partial/\partial t\ (q_tf)(x) = \text{trace}\ [A(x)\ (q_tf)''(x)]$, and (iv) $\lim_{t\to 0} (q_tf)(x) = f(x)$ uniformly. Dissert. Abstr.

N68-36686 California Univ., Berkeley.
INVARIANT SURFACES OF ORDINARY DIFFERENTIAL EQUATIONS WITH AND WITHOUT TIME LAG
Anthony John Schaeffer (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-151

Consider the system of differential equations (1) $\dot\theta(t) = \Theta[\theta(t-r), x(t-r), \epsilon]$ (2) $\dot x(t) = A[\theta(t-r), \epsilon]\, x(t-r) + X[\theta(t-r), x(t-r), \epsilon]$, where $r \geq 0$ when there is no time lag. A mapping $S : R^m \to R^n$ is an invariant surface of (1,2) if the pair $[\psi(t), S[\psi(t)]]$ is a solution of (1,2) where $\psi(t)$ is a solution of the equation (3) $\dot\theta(t) = \Theta[\theta(t-r), S[\theta(t-r)], \epsilon]$, which must be defined for all time if $r > 0$. In this paper, for $\epsilon = 0$, it is assumed that $S_0(\theta) \equiv 0$ is an invariant surface of (1,2), and it is shown that under suitable conditions on Θ, A, and X there exists a unique invariant surface of (1,2) near S_0 for ϵ small. More general time lag terms are allowed in the paper and a systematic treatment of differential equations with time lag is given. Dissert. Abstr.

N68-36694# California Univ., Berkeley. Operations Research Center.
AN EXPERIMENTAL STUDY ON SOLVING LINEAR PROGRAMS
Arunachalam Ravindran Mar. 1968 37 p refs
(Contract Nonr-222(83); Grant NSF GP-7417)
(ORC-68-5; AD-673671)

An experimental study to compare the simplex method and the Lemkes method to solve linear programs is made. The M3 code for simplex method and the authors code for the Lemke method were used in the study. Comparison was made only with regard to the number of iterations each method takes and our little study shows encouraging results about the superiority of Lemke method, but no general recommendation is made by the author due to size of the study and data. A by-product of our study is a complementary pivot algorithm to solve linear programs which is a modification of the Lemkes method and which saves a considerable storage and time of computation. Author (TAB)

N68-36706 Tulane Univ., New Orleans, La.
HOLOMORPHIC BEHAVIOR IN UNIFORM ALGEBRAS ON NON-COMPACT SPACES
William Elwood Meyers (Ph.D. Thesis) 1967 63 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 67-17932

An algebra of continuous complex-valued functions on a topological space X which is closed in the topology of uniform convergence on compact subsets of X and contains the constant functions is called a uniform algebra. Preliminary propositions are obtained which extend some results known for uniform algebras on compact spaces (in particular, for function algebras) to general uniform algebras. Restriction algebras are studied, and it is shown that a local peak point of a uniform algebra $\hat A$ in the space M(A) of continuous homomorphisms on A is a peak point of any restriction algebra $\hat A|K$ where K is a compact subset of M(A) containing p. Also, a condition for the existence of a non-zero topological zero divisor in A is found. Attention is limited to uniform algebras on a Riemann surface X. Dissert. Abstr.

N68-36707 Tulane Univ., New Orleans, La.
SUPPLEMENTS FOR THE IDENTITY COMPONENT IN LOCALLY COMPACT GROUPS
Dong Hoon Lee (Ph.D. Thesis) 1967 48 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17929

Properties of automorphisms of a Lie algebra are investigated. Let L be a semisimple real Lie algebra of finite dimension and let Aut(L) (resp. Int(L)) denote the group of all automorphisms (the normal subgroup of all inner automorphisms) of L. Let $L = K + P$ be a Cartan decomposition of L into a maximal compactly embedded subalgebra of L and a subspace P. H_k any maximal abelian subalgebra of K, and let H be a unique maximal abelian subalgebra containing H_k. Let K_c be the complexification of the semisimple commutator subalgebra K' of K and let $H'_0 = H_0 \cap K'_c$, where H_0 is the real part of the Cartan subalgebra of H_c which is generated by H. As an easy corollary to the result, it is proved that the group of automorphisms of compact connected Lie group G splits over the normal subgroup consisting of all inner automorphisms of G. Dissert. Abstr.

N68-36713# Stanford Univ., Calif. Dept. of Computer Science.
EPSILON-CALCULUS
Paul L. Richman 16 Aug. 1968 147 p refs
(Contract N00014-67-A-0112; Grant AF-AFOSR-1047-68)
(CS-105; AD-673674)

Recursive function theory is used to lay the basis for a partially constructive theory of calculus, which we call the epsilon-calculus. This theory differs from other theories that have grown out of recursive function theory in that (1) it is directly related to the variable-precision computations used in scientific computation today, and (2) it deals explicitly with intermediate results rather than ideal answers. As epsilon approaches zero, intermediate results in the epsilon-calculus approach their corresponding answers in the calculus. Thus we say the epsilon-calculus approaches the calculus, as epsilon approaches zero. It is hoped that investigations in the epsilon-calculus will lead to a better understanding of numerical analysis. Several new results in this direction are presented, concerning instability and also machine numbers. Discrete notions of limit, convergence, continuity, arithmetic, derivative and integral are also presented and analyzed. Author (TAB)

N68-36753*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CLASSICAL FIFTH-, SIXTH-, SEVENTH-, AND EIGHTH-ORDER RUNGE-KUTTA FORMULAS WITH STEPSIZE CONTROL

Erwin Fehlberg Washington Oct. 1968 87 p refs
(NASA-TR-R-287) CFSTI: HC $3.00/MF $0.65 CSCL 12A

In this paper we shall derive classical Runge–Kutta formulas of the fifth, sixth, seventh, and eighth order including a stepsize control procedure which is again based on a complete coverage of the leading local truncation error term. Naturally, these new formulas require more evaluations per step of the differential equations than the known classical Runge–Kutta formulas without stepsize control procedure. Author

N68-36788*# Northeastern Univ., Boston, Mass.
RESTRICTED MINIMA OF FUNCTIONS OF CONTROLS
J. Warga *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 51–76 refs (See N68-36785 23-30)
(Grant NGR-22-011-020)

It is assumed that the topological space is the Euclidean n-space E_n. Certain necessary conditions for minimum are investigated that might be considered a generalization of the Weierstrass E-condition and of the transversality conditions of the calculus of variations. In this sense the results represent an extension of certain methods and theorems of the mathematical control theory to a more general setting. The necessary conditions that are obtained are no longer restricted, however, to minima over the space of relaxed controls but apply as well to minima over the space of original controls (if such minima exist). Thus the present results also generalize Pontryagin's maximum principle. Furthermore, the space of original controls is no longer restricted to measurable mappings from one metric compact set to another. The basic results are stated directly in the form of inequalities involving the value of the minimizing control at an arbitrary point rather than the form of functional inequalities. Author

N68-36789*# Northeastern Univ., Boston, Mass.
THE REDUCTION OF CERTAIN CONTROL PROBLEMS TO AN ORDINARY DIFFERENTIAL TYPE
J. Warga *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 77–84 (See N68-36785 23-30)
(Grant NGR-22-011-020)

Some observations are presented that appear to have been overlooked by some workers in mathematical control theory faced with problems that are not of the ordinary differential type. Three specific examples are given of how one may transform the problem to one which is immediately treatable with classical results of control theory. Author

N68-36794*# Control Research Associates, Baltimore, Md.
PERTURBATION OF SOLUTIONS OF DIFFERENTIAL EQUATIONS SATISFYING GENERAL BOUNDARY CONDITIONS
Daniel C. Lewis (Johns Hopkins Univ.) *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 173–192 (See N68-36785 23-30)
(Contract NAS12-93)

The perturbation problem for a system of nonlinear differential equations under general linear (but not necessarily homogenous) two point boundary conditions is reduced to the problem of solving k bifurcation equations, where k is the degeneracy of the problem. In the nondegenerate case k = 0, the set of such equations is vacuous and the problem is automatically solved. If k = 0 and if there are k independent first integrals, a significant transformation of the bifurcation equations in terms of these first integrals is carried out. The largest section of the paper is concerned with the construction of generalized Green's matrices (and with kindred matters) for linear systems with boundary conditions of arbitrary degeneracy. The generalized Green's matrix for the variational equations is prerequisite to our treatment of the nonlinear problem. Author

N68-36795*# International Business Machines Corp., Cambridge, Mass. Center for Exploratory Studies.
HIGH ORDER TIME DERIVATIVES OF POWERS OF THE RADIUS VECTOR
P. Sconzo and D. Valenzuela *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 193–211 (See N68-36785 23-30)
(Contract NAS12-87)

The derivatives of a function were automatically computed applying the recursive Schlömilch–Cesàro formulation. Tables given for this purpose in collections of mathematical formulas were thus extended up to the eighteenth order. Then, the general expressions thus obtained were used to construct the power series expansions in the time variable of those powers of the radius vector which appear most frequently in celestial mechanics, namely, the force function, the force of attraction, and the derivatives of the force function with respect to the coordinates. These last expressions are given in terms of the radius vector evaluated at origin and the triplet of Stumpff's local invariants. The explicit expressions of these series were symbolically computed using the FORMAC language. Author

N68-37046# Aktiebolaget Atomenergi, Studsvik (Sweden).
NUMERICAL INTEGRATION WITH ADAPTIVE MONTE CARLO METHODS [NUMERISK INTEGRATION MED ADAPTIVA MONTE CARLO METODER]
Bo Eriksson 3 Jan. 1968 26 p refs In SWEDISH
(NP-17485; RFN-301)

An adaptive Monte Carlo method is introduced. A numerical integration method which is applicable to the integration of positive strongly varying functions is introduced using the adaptive Monte Carlo method. NSA

N68-37073*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMBINED NEWTON–RAPHSON AND GRADIENT PARAMETER CORRECTION TECHNIQUE FOR SOLUTION OF OPTIMAL-CONTROL PROBLEMS
Ernest S. Armstrong Washington Oct. 1968 64 p refs
(NASA-TR-R-293) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A parameter correction technique is developed to solve a boundary value problem which frequently occurs in optimal control theory. It is assumed that an indirect optimal control method was applied to a controllable dynamic system with a two point boundary value problem resulting such that the boundary conditions take the form of a set of unknown parameters to be determined to meet an equal number of terminal conditions. The optimal control law is a piecewise continuous function with discontinuities occurring only at the zeros of certain continuous functions. A procedure is developed to improve upon an assumed set of parameters so that, by repetitive use of a correction formula, a monotonic decreasing sequence of values of a positive definite function that measures the terminal errors is produced. The direction of the correction vector is found to lie between the directions given by the gradient and the Newton–Raphson procedures. The procedure is applied to the determination of both planar and non-planar fuel optimal trajectories for a space vehicle which is launched from the surface of the moon and required to rendezvous with a space vehicle in a circular orbit. Author

N68-37108# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATISTICAL METHODS FOR DESIGN OF EXTREMAL EXPERIMENTS

V. V. Nalimov and N. A. Chernova 9 Jan. 1968 419 p refs Transl. into ENGLISH of the book "Statisticheskiye Metody Planirovaniya Ekstremal'nykh Eksperimentov" Moscow, 1965 p 1–340
(FTD-HT-23-660-67; AD-673747)

The book presents modern statistical methods for design of experiments aimed at determining optimal conditions for complex processes. The following topics are considered in detail: the complete factorial experiment and fractional replicas; steepest ascent along the response surface; description of an almost stationary region; screening experiments; adaptive optimization of industrial processes. The material is presented in the language of matrix algebra. In many cases, the examples used are taken from studies carried out in the laboratories where the authors are employed. Particular attention is paid to the physical-chemical interpretation of research results. TAB

N68-37241# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
DESIGN OF PHYSICAL EXPERIMENTS (REVIEW) [PLANIROVANIE FIZICHESKIKH EKSPERIMENTOV (OBZOR)]
A. Pazman and V. V. Fedorov 1967 61 p refs In RUSSIAN; ENGLISH summary
(JINR-P1-3612)

The existing statistical methods of designing experiments are described in a universally accessible form. Author (NSA)

N68-37251 Bolkow Entwicklungen K. G., Munich (West Germany).
ANALYSIS OF LINEAR AND NONLINEAR SYSTEMS WITH VARIABLE PARAMETERS AND RANDOM INPUT VARIABLES. PART 1: LINEAR SYSTEMS [ANALYSE LINEARER UND NICHTLINEARER SYSTEME MIT VARIABLEN PARAMETERN BEI REGELLOSEN EINGANGSGROESSEN. TEIL 1: LINEARE SYSTEME]
Werner Wiemer 1968 21 p refs In GERMAN Presented at Carl-Cranz-Ges., 18–21 Jun. 1968
(RS-30-O)

Two methods are presented for calculating the variance and covariance of linear, time-variable differential equations. The first method makes use of the adjoint system, and the variance is calculated on discrete points. In the second method a process is derived which permits the continual calculation of the variances and covariances. Both methods require the use of an analog or digital computer. Transl. by K.W.

N68-37284 Michigan Univ., Ann Arbor.
VECTOR SEQUENCE SPACES
David Allan Gregory (Ph.D. Thesis) 1967 84 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17766

A general study of scalar sequence spaces (s.s.s.) was begun in 1934 by Köthe and Toeplitz. In this dissertation, vector sequences spaces (v.s.s.) are studied. A v.s.s. is a linear space S(E) of sequences of vectors chosen from a vector space E. The operations on S(E) are the usual componentwise ones and S(E) is assumed to contain all those sequences in E that have only a finite number of entries not equal to the zero vector. S(E) is provided with a topology T so that (S(E),T) is an l.c.t.v.s. Results on compact, countably compact, and sequentially compact subsets of (S(E),T) are obtained. Additional results are obtained for the case when (E,T) is a Banach space. The theory of s.s.s. has been a fundamental tool in summability theory and has enjoyed occasional applications to the theory of bases, analytic function theory, and distribution theory. The theory of v.s.s. therefore shows promise as a useful tool in the study of the vector valued generalizations of these theories. Dissert. Abstr.

N68-37400*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION AND ANALYSIS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 24–28 ref (See N68-37397 23-11)

Reviewed are (1) properties of two orthonormal transformations, the Jacobi transformation and the Householder transformation, used in solving systems of linear equations or computing eigenvalues or singular values of a matrix; and (2) properties of a third orthonormal transformation, designated RSP (Rotation in a Selection Plane), that combines the Householder-like ability to transform m-1 elements of an m-vector to zero in a single transformation with the Jacobi-like property of using a plane rotation instead of a reflection. Geometric interpretations of the three transformations are given. It is concluded that: (1) the Jacobi transformation is most applicable in cases in which the pattern of elements to be zeroed is somewhat irregular; (2) the Householder transformation is more accurate and more economical when a number of elements in one column are to be zeroed; (3) the RSP transformation is nearly as economical as the Householder transformation and could reasonably be used in the same circumstances; and (4) although the Householder transformation is very stable with regard to roundoff error propagation, the RSP transformation may be even slightly more stable. S.C.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-36096# Weather Bureau, Silver Spring, Md. Office of Hydrology.
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL IN THE UNITED STATES COASTAL REGION ON THE GULF OF MEXICO
Hugo V. Goodyear Jul. 1968 38 p refs
(WB-7) GPO: HC $3.00; CFSTI: MF $0.35

The frequency and areal distributions of rainfall from tropical storms entering the Gulf Coast between Apalachicola, Fla., and Brownsville, Tex., were investigated. Forty-six well-developed storms during the 26-year period 1940–65 provided the basic data. The rainfall investigated was for the 48-hour period from 24 hours before landfall to 24 hours after. The results of the investigation are presented on a series of charts showing the spatial distribution of 12-, 24-, and 48-hour rainfall up to 100 miles inland and within 150 miles on either side of the storm track. Another series shows distributions of 6- and 12-hour point rainfalls for the 2-, 10-, 25-, and 50-percent frequency levels in five 25-mile zones parallel to the coast and extending 125 miles on each side of the storm track. Average rainfalls for 12-, 24-, and 48-hour periods show maximum values 25 to 50 miles to the right of the storm track. The first 24-hour period of rainfall indicates an offshore maximum, but the second shows a maximum 25–50 miles inland. The four 12-hour periods show a gradual inland movement of the center of maximum rainfall from offshore to 50–75 miles inland for the fourth period. Dissert. Abstr.

N68-36110# Environmental Science Services Administration, Silver Spring, Md. Environmental Data Service.
AN APPLICATION OF THE GAMMA DISTRIBUTION FUNCTION TO INDIAN RAINFALL
D. A. Mooley (Inst. of Topical Meteorol., Poona, India) and H. L. Crutcher (Natl. Weather Record Center, Asheville, N. C. Jul. 1968 53 p refs
(EDS-5)

This study investigates (1) whether the monthly monsoon rainfall at Indian stations can be characterized by the incomplete gamma distribution function, (2) the length of period required to permit stabilization of the estimates of the distribution parameters, and (3) the correlation of month-to-month rainfall during the monsoon season. Chi-square (χ^2) and the more powerful Kolmogorov–Smirnov (K–S) tests are used to test the applicability of the gamma distribution. The results are (1) The null hypothesis of no difference between the theoretical and actual distribution is tested. The null hypothesis is not rejected. (2) Two stations, Bombay and Calcutta, each with more than 130 years of data, are used to determine the stabilization period. The assumption is made that stabilization certainly would be reached at 130 years. The interval determined by the mean of the estimates plus and minus one standard deviation of the respective estimates is used as the criterion. The inference is made that stabilization is reached somewhere between 80 and 100 years. (3) There is essentially no linear relationship between months of rainfall. Author

N68-36151# Space Instruments Research, Inc., Atlanta, Ga.
UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (BARBADOS, 15–16 FEBRUARY 1967)
John A. Fagot Apr. 1968 61 p refs
(Contract DA-01-009-AMC-169(X))
(Rept.-9; BRL-CR-169-9; AD-673775)

During the night of 15-16 February 1967, eight luminous trails were produced between 88km and 123km by the release of tri-methyl aluminum from projectiles fired from a smothbore sixteen-inch gun located on the West Indian Island of Barbados (57.5 degrees W, 13.1 degrees N). These trails were photographed from neighboring islands and analyzed to yield wind profiles. The report contains the tabulated wind data from all eight trails together with plots versus altitude of wind components, wind speed, wind heading, and wind shear components. Author (TAB)

N68-36153# Space Instruments Research, Inc., Atlanta, Ga.
UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (BARBADOS, 19–20 SEPTEMBER 1966)
John A. Fagot and William Epler Apr. 1968 62 p refs
(Contract DA-01-009-AMC-169(X))
(Rept.-8; BRL-CR-169-8; AD-673776)

During the night of 19-20 September 1966 eight luminous trails were produced between 86 km and 135 km by the release of tri-methyl aluminum from projectiles fired from a smoothbore sixteen inch gun located on the West Indian Island of Barbados (57.5 degrees W; 13.1 degrees N). These trails were photographed from neighboring islands and analyzed to yield wind profiles. This report contains the tabulated data from all eight trails together with plots versus altitude of wind components, wind speed, wind heading, and wind shear components. Author (TAB)

N68-36188# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ATMOSPHERIC STRUCTURE, WHITE SANDS MISSILE RANGE, NEW MEXICO. PART 1: SURFACE WIND, CLOUD COVER, VISIBILITY
Marjorie McLardie Hoidale, Barbara Jean Gee, and George W. Harmon Ft. Monmouth, N. J. Army Electron. Command Jul. 1968 176 p refs
(ECOM-5202; AD-673718)

A statistical analysis of surface wind velocity, sky condition, and visibility is presented for Station A, White Sands missile range. This climatological information is based on the period of observation from 1951-1967. Author (TAB)

N68-36190# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FIVE-INCH GUN METEOROLOGICAL SOUNDING SITE, HIGHWATER, QUEBEC
Eugene D. Boyer Jul. 1968 28 p refs
(BRL-MR-1929; AD-673712)

The use of a meteorological gun-probe in a confined area has been demonstrated. A program utilizing the 5 in. HARP system at Highwater, Province of Quebec, near the Vermont state border, is described. Wind soundings were made to altitudes of 230,000 ft with a ground impact area limitation of 1 sq mi for the spent projectile. Author (TAB)

N68-36191# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A SURVEY OF PROBABLE SURFACE WINDS ALONG TRAJECTORIES OF SMALL ROCKETS
Paul G. Baer Jul. 1968 94 p refs
(BRL-1407; AD-673711)

A survey of the micrometeorological literature was conducted to determine the probable surface winds a small rocket will encounter along its trajectory. Micrometeorological theory, model studies in wind tunnels, and field observations pertinent to the objectives of the study are discussed. Author (TAB)

N68-36284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PECULIARITIES OF THE DISTRIBUTION OF INCREASED TURBULENCE ZONES AT ALTITUDES IN THE ARCTIC [OSOBENNOSTI RASPREDELENIYA ZON POVYSHENNOI TURBULENTNOSTI NA VYSOTAKH V ARKTIKE]
A. M. Kavrova Jul. 1967 30 p refs Transl. into ENGLISH from Tr. Arkticheskogo i Antarkt. Nauchno-lasled. Inst. (Leningrad), v. 266, 1964 p 132–142
(FTD-MT-66-172; AD-673453)

The paper describes the distribution of turbulence aloft in the Arctic, especially zones of high turbulence. The study was based on temperature and wind sounding data from 13 Soviet and non-Soviet polar stations for the period 1958-1960 and from drifting stations over a longer period of years. At these stations, the probability of zones of high turbulence was determined for the characteristic months of the seasons: January (winter), April (spring), July (summer) and October (autumn). Data from 7,500 radiosonde launchings were analyzed. An indirect method was used to determine the probability of zones of high turbulence. Author (TAB)

N68-36375 Stanford Univ., Calif.
AN INTEGRATED METEOR RADAR SYSTEM FOR WIND AND DENSITY MEASUREMENTS IN THE UPPER ATMOSPHERE
Robert Nowak (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17471

The theory of radio reflection from meteor trails is reviewed, and, based on its predictions, the specifications for a muliparameter meteor radar are derived. The synthesis of a completely integrated, coherent pulse radar is described; with this radar, echo strength, range, elevation angle, and doppler shift of the signals reflected from trails can be measured. The main features of this system are digital recording and processing of the data; the use of a composite signal waveform that permits simultaneous measurement of range, amplitude, and doppler at low peak power; and the recording of both amplitude and sign of the doppler shift in one channel. Data are processes automatically; the radar station is inexpensive and reliable enough to provide the basis for multistation synoptic

measurements of upper atmospheric winds. The performance of the system is analyzed and measurements with three antenna arrangements are described. Echo heights are determined directly at high elevation angles from range and angle of arrival. It is shown that the height of reflection can be related to the amplitude decay of a certain class of echoes. Dissert. Abstr.

N68-36407# Freie Univ., Berlin (West Germany).
DAILY AND MONTHLY NORTHERN HEMISPHERE 10-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1967. PART 2: APRIL-JUNE Quarterly Technical Status Report, Apr.-Jun. 1967
Dietrich Just, Barbara Kriester, Karin Labitzke, Renate Lenschow, and Karin Petzoldt 1968 107 p
(Contract DAJA37-67-C-0786)
(QTSR-2; AD-673814)

These reports are published quarterly and present 10 mb maps, day by day, throughout 1961-present. Height and temperature data are plotted on each chart and appropriate contours are drawn. A discussion of the stratospheric circulation for each quarter is included. Each volume also contains mean monthly maps and charts of changes in the means from month to month, for the appropriate months. Author (TAB)

N68-36421# Joint Publications Research Service, Washington, D. C.
METEOROLOGY AND HYDROLOGY, NO. 7, 1968
1 Oct. 1968 171 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 7, Jul. 1968 p 3-124
(JPRS-46566) CFSTI: HC $3.00/MF $0.65

Eight selected articles are presented which treat theoretical and practical aspects of meteorology; a ninth article on hydrology describes visual studies of large-scale turbulence effects on the distribution of suspended sediments with respect to flow depth. The articles on meteorology deal specifically with: (1) model studies of diurnal variations in atmospheric temperature and circulation and of global waves in a rotating stratified atmosphere; (2) fog and low stratus cloud recognition on photographs taken by Cosmos and ESSA satellites; (3) pressure and temperature effects on the stratospheric circulation in the Northern Hemisphere during the cold seasons; (4) techniques for forecasting frontal precipitation and heavy summer squalls; (5) conversion of wind velocity data obtained by balloon probes into rawinsonde data; and (6) an electrical training device for testing flight crews in cloud recognition and identification. K.W.

N68-36422# Joint Publications Research Service, Washington, D. C.
THEORETICAL MODEL OF DIURNAL VARIATIONS OF METEOROLOGICAL FIELDS
V. G. Vagar and S. S. Zilitinkevich *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 1-19 refs (See N68-36421 23-20)

A model of a nonstationary turbulent Ekman boundary layer is proposed. The problem of diurnal variations of meteorological fields is formulated on the basis of this model. Horizontal components of wind velocity, potential air temperature, turbulent exchange coefficient, turbulence energy, displacement path, and rate of dissipation of turbulent energy as heat are all considered as unknowns. As a result of the difficulties connected with including the exchange coefficient among the functions subject to definition, the statement of the problem is simplified as much as possible in all other respects. Heat exchange processes on the underlying surface and in the soil are not considered. The diurnal temperature variations on the lower boundary of the boundary layer are considered to be given (sinusoidal) directly in the case. The radiation heat exchange in the atmosphere and the processes of moisture exchange and evaporation are not considered. The results of the numerical computer calculations are compared with experimental data. Author

N68-36423# Joint Publications Research Service, Washington, D. C.
THE THEORY OF GLOBAL WAVES IN A ROTATING STRATIFIED ATMOSPHERE
A. I. Ivanovskiy and Yu. V. Semenovskiy *In its* Meteorol. and Hydrol., No. 7, 1968, 1 Oct. 1968 p 20-35 refs (See N68-36421 23-20)

This article contains the results of solving the modified Laplace tidal equations. These results are used to solve the problems of semidiurnal and diurnal tides in the atmosphere, zonal oscillations, and long-wave theory in the troposphere and stratosphere. Author

N68-36424# Joint Publications Research Service, Washington, D. C.
FOG AND LOW STRATUS CLOUDS ON PHOTOGRAPHS TAKEN FROM THE COSMOS AND ESSA SATELLITES
L. S. Minina *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 36-47 refs (See N68-36421 23-20)

This article contains examples of images of fog and low stratus clouds on photographs obtained with the help of the Cosmos and ESSA satellites. The peculiarities for fog recognition by a set of television and infrared images are pointed out along with additional characteristics which a weather forecaster may obtain by using satellite data. Author

N68-36425# Joint Publications Research Service, Washington, D. C.
CAUSES OF TRANSFORMATIONS OF STRATOSPHERIC CIRCULATION IN THE NORTHERN HEMISPHERE IN THE COLD PART OF THE YEAR
Yu. I. Bashta and A. P. Kudryan' *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 48-57 refs (See N68-36421 23-20)

This article contains an analysis of variations of the pressure field in the atmosphere, variations at the 300 and 30 millibar surfaces, and variations in the thickness of the layer between the 300 and 30 millibar surfaces. Large scale transformations of circulation in the middle stratosphere were studied, and it is shown that these transformations significantly affect temperature variations at the 30 millibar level and in the layers between the 300 and 30 millibar levels. This indicates that the temperature field of the stratosphere plays an important role in forming stratospheric circulation not only during the warm, but also during the cold half of the year. K.W.

N68-36426# Joint Publications Research Service, Washington, D. C.
APPLICATION OF THE METHOD OF PROBABILITY LOGIC TO FORECASTING FRONTAL PRECIPITATION
E. S. Il'inova and E. Ya. Ran'kova *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 58-64 refs (See N68-36421 23-20)

Results are presented of numerical experiments in forecasting precipitation in northwesterly and westerly winter intrusion of air in Tashkent by the method of information-probability logic. The parameters characterizing the moisture content of the air masses, the position of the front, the baric field, and the predominant currents were considered to be the predictors. Combinations of 10 and 18 attributes were used in the experiments. Author

N68-36427# Joint Publications Research Service, Washington, D. C.
FORECASTING HEAVY SQUALLS
B. Ye. Peskov and A. I. Snitkovskiy *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 65–73 refs (See N68-36421 23-20)

A procedure is proposed for forecasting heavy summer squalls based on the relations between the maximum wind velocity during the squalls and thickness of the cloud, the sum of the wind velocities between the ground layer and the 500 millibar level, and the thickness of the cloud layer between the condensation level and the height of the −10° isotherm. Author

N68-36428# Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF THE EFFECT OF LARGE-SCALE TURBULENCE ON THE DISTRIBUTION OF SUSPENDED SEDIMENT WITH RESPECT TO FLOW DEPTH
L. D. Kozyrenko *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 74–82 refs (See N68-36421 23-20)

The distribution of suspended particles with respect to flow depth in the presence of secondary currents in the flow (large-scale eddy masses) has been investigated by photographic and visual techniques in order to determine the possibilities of using the existing suspension theories. Conclusions are drawn concerning the applicability of the formulas of the diffusion and gravitational theories of suspensions taking the flow structure into account. Author

N68-36429# Joint Publications Research Service, Washington, D. C.
THE USE OF THE DIFFERENCE METHOD FOR REDUCING BALLOON OBSERVATIONS TO RADIOWIND OBSERVATIONS
V. M. Sklyarov *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 102–109 refs (See N68-36421 23-20)

A method for eliminating the inhomogeneity of wind velocity data obtained over many years from the results of balloon and radiowind observations is discussed. The method may be used in aeroclimatological research, especially when studying the diurnal course of the wind in the planetary boundary layer of the atmosphere. Author

N68-36430# Joint Publications Research Service, Washington, D. C.
ELECTRIC TRAINING CONTROLLER FOR TESTING THE KNOWLEDGE OF STUDENTS ABOUT CLOUDS
V. V. Zhukovskiy *In its* Meteorol. and Hydrol., No. 7, 1968 1 Oct. 1968 p 110–113 (See N68-36421 23-20)

A simple electrical training device is described which is designed to test flight crews on cloud recognition and identification, including types of clouds, morphological peculiarities, cloud characteristics, the flight conditions in the clouds, and hazardous phenomena observed in the clouds. The training controller consists of a sheet of plywood with 20 pictures of clouds of the upper, middle, and lower levels and of vertical development. A light is mounted above each cloud picture, switched on by a button or tumbler mounted under the picture. The test method used in connection with the device is briefly discussed. K.W.

N68-36436# Naval Research Lab., Washington, D. C.
MEASUREMENT OF ATMOSPHERIC DEWPOINT FROM AIRCRAFT
Robert E. Ruskin 12 Jun. 1968 16 p refs
(NRL-6725; AD-673398)

By cooperative efforts of government and industry, the absolute measurement of atmospheric humidity has now become practical under operational aircraft flight conditions by use of thermoelectrically cooled dewpoint hygrometers with optical detection of condensate and automatic mirror temperature control. Effects of salt contamination can be minimized by in-flight check and adjustment of the dew thickness control level with the contamination present on the mirror. Interfacing of the sensor and aircraft is not amenable to a universal solution for all aircraft; but a mounting arrangement has been developed to permit in-flight adjustment of flow and pressure at the sensor. On Navy Constellation aircraft, a radome can be used as a rain deflector to reduce the entry of liquid water while flying in hurricanes or other precipitation. Mechanical aspiration of the sensor can remove accumulated water in rain and permit measurement of dewpoint on the ground. However, because the dynamic heating evaporates water at any aircraft surface or instrument, data in clouds or precipitation in general must indicate humidity greater than saturation with any type of hygrometer. Total evaporation of cloud water can provide useful information on the total water content of the clouds with a dewpoint instrument designed for this purpose. Author (TAB)

N68-36487# Allied Research Associates, Inc., Concord, Mass.
SATELLITE-OBSERVED CHARACTERISTICS OF SEVERE LOCAL STORMS Final Report
Earl S. Merritt and Walter P. Smith Apr. 1968 50 p refs
(Contract E-202-67(N))
(ARA-8G49-F; PB-178752) CFSTI: HC$3.00/MF$0.65

Studies of satellite observations of local severe storm occurrences over the central and eastern United States during the periods April–June 1965 and 1966 have revealed several characteristics potentially useful to prediction of severe local storm occurrences. Among these characteristics are: (1) Satellite-observed cells larger than one degree of great circle arc are excellent predictors of severe local storm occurrences, i.e., tornadoes, hail, damaging winds. The severe local storm occurs, on the average, one and one-half hours after the observation of a one degree or larger cell; (2) Satellite cloud patterns in large scale weather systems can provide information on circulation characteristics directly related to the empirical patterns developed by Fawbush and Miller; (3) Shortwave cloud patterns observed by satellite and associated with middle troposphere short waves, but not easily corroborated with conventional circulation features, are often related to squall-line-type severe weather occurrences. The patterns appear to develop when a very short wave at 500 mb moves over a moist tongue at 850 mb. Author (USGRDR)

N68-36491# Weather Bureau, Silver Spring, Md.
CLIMATOLOGY OF ATLANTIC TROPICAL STORMS AND HURRICANES
M. A. Alaka May 1968 22 p refs
(WB-6) CFSTI: HC$3.00/MF$0.65

The climatology of Atlantic tropical storms and hurricanes is derived from data from 1871 to 1963. There are sections on hurricane formation, frequency, motion, and structure. Under these headings, the thermodynamics and mechanics of hurricane formation, the upper and lower level wind flow, seasonal and secular variations in storm frequency, storm movement, stroms affecting the United States, and the wind, pressure, and rainfall patterns associated with these storms, are discussed and illustrated. Author

N68-36552# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 188 12 Sep. 1968 p 10–33 refs (See N68-36550 23-13)

Russian news and scientific articles in the field of meteorology are abstracted. A book dealing with the fundamental elements and

systems of automatic and telemetric devices used in making hydrometeorological measurements is reviewed. An investigation is made of electric circuit variants of automatic telemeters for temperature difference measurements. Theoretical mathematical solutions are presented for convection in the presence of wind shear, unidimensional stochastic ice drift, thermotropic model for hemisphere forecasting, hydrodynamic model of circulation, anisotropic pressure field space–time correlation function, true brightness fields from smoother field, atmospheric density model, and computer determination of atmospheric circulation. Analyses and discussions are made for heavy glaze–rime deposits, glaze loads, atmospheric impurities in precipitation, conditions fostering thunderstorm development, melting hailstones, annual river runoff, and Antarctic weather observations. B.P.

N68-36563# Environmental Science Services Administration, Washington, D. C.
ESSA SCIENCE AND ENGINEERING, 13 JULY 1965 TO 30 JUNE 1967
Apr. 1968 157 p refs
GPO: HC $1.50; CFSTI: MF $0.65

The various science and engineering activities are reviewed within the two-dimensional framework of ESSA missions and objectives. The purpose is to present ESSA from a multidisciplinary point of view which emphasizes the application of the methods, procedures, and techniques of various interrelated scientific disciplines to the solution of major problem areas in environmental science and technology. The study deals exclusively with those activities pursued during the first two years of ESSA's existence. The various aspects of the science and engineering programs are delineated with respect to organization, products,accomplishments of a singular nature, description of environment, environmental prediction and warning, and supporting activities. B.S.D.

N68-36582# National Science Foundation, Washington, D. C.
WEATHER MODIFICATION Annual Report, Year Ending 30 Jun. 1967
28 Aug. 1968 105 p refs
(NSF-68-21; AR-9) GPO: HC $0.40; CFSTI: MF $0.65

A summary of the weather modification programs sponsored by various departments of the Federal Government, and foreign governments is presented. The modification programs include: (1) modification of precipitation, (2) hail suppression, (3) fog dissipation, and (4) cloud electricity, lightning, and severe storms. The social, economic, legal and ecological aspects of these modifications are considered. A list of funded programs indicating reporting agency, investigating agency, and costs is included. F.O.S.

N68-36656*# Boeing Co., Seattle, Wash. Space Div.
WIND TOWER INFLUENCE STUDY (FOR NASA'S 150-METER METEOROLOGICAL TOWER AT KENNEDY SPACE CENTER, FLORIDA)
J. W. Hathorn 23 Sep. 1968 62 p refs
(Contract NAS8-5608)
(NASA-CR-61242; D5-15566) CFSTI: HC $3.00/MF $0.65 CSCL 04B

This tower facility serves to acquire lower atmosphere data for use in the development of space vehicle environmental criteria. An experimental study was designed following a literature search. This study provided data to judge the tower's influence on wind measurements and to establish correction factors if required. The correction factors were computed by determining the ratios and deviations between the measured and reference mean wind speeds and directions, respectively. It was also determined whether: (1) the tower influence field is bilaterally symmetrical about the structural axis of symmetry; and (2) the influence fields are the same for all levels of the tower. The maximum influence on the wind speed occurred when the wind flow was through the tower. The maximum directional deviation, −9°, occurred when the wind was from the east-southeast and the minimum deviations, ±2°, when the winds were from the north quadrant. The stream function was computed about a solid triangular tower using a numerical technique to solve the Laplace equation. K.W.

N68-36731*# IIT Research Inst., Chicago, Ill.
FEASIBILITY OF MULTI-SATELLITE OCCULTATION (REFRACTION) MEASUREMENTS FOR METEOROLOGY Final Report
Jerrold D. Miller and Howard J. Goldman Aug. 1968 35 p refs
(Contract NASr-65(25))
(NASA-CR-97115; TM-28) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Considered is the feasibility of a multiple satellite occultation technique for obtaining global profiles of atmospheric density and pressure. Two concepts are discussed in detail: (1) the first uses a mother satellite and six daughter satellites in the same polar orbit to measure radio wave path lengths between them as an indication of atmospheric refractivity. Phase and Doppler frequency measurements at five altitudes on a global basis are then evaluated for conditions at a point near minimum altitude; and (2) the second method utilizes two satellites in different orbits that continuously approach and move away from each other. Doppler shift measurements on atmospheric refraction provide continuous vertical coverage from the top of the atmosphere to the earth's surface. G.G.

N68-36745 Missouri Univ., Columbia.
A MONTE CARLO METHOD FOR ESTIMATING THE ERROR VARIANCE AND POWER OF THE TEST FOR A PROPOSED CLOUD SEEDING EXPERIMENT
Paul Thomas Schickedanz (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-326

A method is presented for obtaining a preliminary estimate of the error variance and power of the test of a proposed experimental design for various numbers of sampling units and replications. A generation model was constructed and applied to daily rainfall data from the period June 1–15, 1935–1965. The model involves the definition of a mixed distribution function which allows for both non-zero and zero rainfall. Using this model, a Monte Carlo method was employed to generate synthetic climatological data for a twenty-year period with various densities of rain gauges. The simulated rainfall data were used to estimate the change in error variance of a hypothetical cloud seeding experiment induced by varying the density of rain gauge network and the length of the experiment. These estimates were obtained for a design which allows for randomization of seeded and non-seeded days over a single target area. The number of experimental days and rain gauges required to obtain significance by each of the statistical tests are presented. Dissert. Abstr.

N68-36802# Weather Bureau, Salt Lake City, Utah. Western Region.
NUMERICAL WEATHER PREDICTION AND SYNOPTIC METEOROLOGY
Thomas D. Murphy May 1968 22 p refs
(WBTM-WR-30; AD-673365)

The report gives a summary of important developments in numerical weather prediction and discusses their relationship to, and effect on, the practice of synoptic meteorology. TAB

N68-36821# RAND Corp., Santa Monica, Calif.
EFFECTS OF TURBULENCE ON CLOUD-DROPLET COLLISION RATES
C. L. Olson Jul. 1968 44 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5489-PR; AD-673340)

The formation of precipitation in warm cumulus clouds is most simply modeled by a uniform distribution of droplets falling at their terminal velocities in still air. However, it is known that storm clouds possess a large updraft and are turbulent in general. This memorandum discusses the possible mechanisms by which turbulence could affect the growth rate of droplets and reviews present research on this subject. Author (TAB)

N68-36836# RAND Corp., Santa Monica, Calif.
CONVECTION IN A BOX: THE DEPENDENCE OF PREFERRED WAVE NUMBER UPON THE RAYLEIGH NUMBER AT FINITE AMPLITUDE
Stephen H. Davis Aug. 1968 22 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5504-PR; AD-673341)

Using Stuart's shape assumption and a condition of maximum heat transport, it is found that the preferred number of finite roll cells present in Benard convection in a three-dimensional rectangular box tends to decrease with increasing supercritical Rayleigh number in contradiction to the behavior in an infinite layer. But in accordance with experimental observation. This "end effect" might explain the similar wave number decrease observed in the Taylor instability between rotating cylinders. Author (TAB)

N68-36931*# Allied Research Associates, Inc., Concord, Mass.
OBSERVATION OF SEA SURFACE TEMPERATURE PATTERNS AND THEIR SYNOPTIC CHANGES THROUGH OPTIMAL PROCESSING OF NIMBUS 2 DATA Final Report
James R. Greaves, James H. Willand and David T. Chang Sep. 1968 134 p refs
(Contract NASw-1651)
(NASA-CR-97280; Rept.-9G51-F) CFSTI: HC $3.00 CSCL 04B

The results of a study are presented of the optimal processing of Nimbus II satellite data for the observation of sea surface temperature patterns and their synoptic changes. A two phase approach is taken, using multispectral low resolution data for the development of data processing techniques, and single spectral region high resolution data for the actual observation of sea surface temperature patterns. For the optimal detection of cloud contamination in daytime, a combination of visible and water vapor absorption radiation data should be used. A 15% albedo threshold and a 237°K temperature threshold were established for the Nimbus data. For nighttime data, only the water vapor absorption data is available for cloud discrimination, although temperature limits may be placed on the IR data themselves. Computer programs were written to automatically apply these threshold criteria, and to map single or multiple pass clear sky data. An application of Monte Carlo statistical programs utilizing a world wide cloud data bank revealed that observation of rapidly changing transient oceanographic phenomena may not be feasible under certain climatic conditions. Graphs are presented for the Gulf Stream area relating area coverage and the probability of obtaining that coverage as a function of the number of passes. Author

N68-36951# Danish Meteorological Inst., Charlottenlund.
SUMMARIES OF WEATHER OBSERVATIONS AT WEATHER STATIONS IN GREENLAND 1961–1965
1968 213 p
CFSTI: HC $3.00/MF $0.65

Meteorological statistics for Greenland for the period between 1961 and 1965 were automatically computed from synoptic surface observations at 26 weather stations. Concurrent measurements of wind speed and direction were tabulated, as were the frequency of surface winds, clouds and visibility ranges, and surface temperature observations. Occurrences of fog, precipitation, blowing snow, and thunderstorm are also presented in tabular form for each of the weather stations. M.W.R.

N68-37091# Institut Royal Météorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS [OBSERVATIONS CLIMATOLOGIQUES] Monthly Bulletin, May 1968
1968 15 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

Climatological observations performed in Belgium in May 1968 are listed giving daily values of maximum and minimum temperatures, duration and intensity of sun radiation, magnetic variations and β-radioactivity. ESRO

N68-37093# Institut Royal Météorologique de Belgique, Brussels. Régie des Voies Aériennes et Force Aérienne.
SYNOPTIC OBSERVATIONS [OBSERVATIONS SYNOPTIQUES] Monthly Bulletin, Nov. 1966
1967 27 p In FRENCH and DUTCH
CFSTI: HC $3.00/MF $0.65

Synoptic observations from meteorological stations in Belgium for November 1966 are listed. ESRO

N68-37095# Institut Royal Météorologique de Belgique, Brussels.
HYDROMETEOROLOGICAL STUDY OF PRECIPITATIONS ON BELGIAN HYDROGRAPHICAL BASINS. PART 1: THE SEMOIS BASIN [ETUDE HYDROME TEOROLOGIQUE DES PRECIPITATIONS SUR LES BASSINS HYDROGRAPHIQUES BELGES. PREMIERE PARTIE: BASSIN DE LA SEMOIS]
Franz Bultot and Gerard L. Dupriez 1968 71 p In FRENCH
Its Publ. Series A, No. 64
CFSTI: HC $3.00/MF $0.65

The 1951–1965 period is taken as a reference to analyze the precipitations in the Semois Basin. Statistical methods are used to compute the main rainfall at night with respect to seasons and geographical location. ESRO

N68-37119# National Weather Records Center, Asheville, N. C.
METEOROLOGICAL ROCKET NETWORK FIRINGS. DATA REPORT, VOLUME 5, NUMBER 1
Jan. 1968 237 p

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Author

N68-37271# RAND Corp., Santa Monica, Calif.
NUMERICAL MODELING OF ICE DEPOSITION
L. R. Koenig Aug. 1968 45 p refs
(Contract NSF C-415)
(RM-5715-NSF)

A method of computing the rate of growth of ice crystals by deposition is described. Predictions of growth characteristics over the temperature range of −1°C through −35°C are shown and compared with meager experimental data available within this temperature range. The growth rate equations are based on Fick's law of diffusion. In applying this law to nonspherical ice crystals, the analogy between an electrostatic potential field surrounding a charged body and the vapor-density field surrounding a similarly shaped ice crystal is utilized. Allowances are made for effects of force convection caused by the movement of the crystal through the air and the change in axial ratio and bulk density of the ice crystal; these effects are predicted to be significant to the growth rates of atmospheric ice crystals. Author

N68-37378# National Weather Records Center, Asheville, N. C.
A TECHNIQUE FOR DETERMINATION OF A CLIMATOLOGY OF HIGH ALTITUDE BALLOON TRAJECTORIES
Frank T. Quinlan and Lee R. Hoxit Silver Spring, Md. ESSA Oct. 1968 22 p refs Supported by G. T. Schjeldahl Co., Northfield, Minn.
(ESDTM-6) CFSTI: HC $3.00/MF $0.65

For a launch position at Chico, Calif., this technique is employed to obtain the distribution of balloon positions, at the end of designated travel times at 90,000 feet, for seven 2-week periods during the summer. Probability ellipses for these balloon positions are presented. In light of optimum conditions for conducting an experimental series employing a large instrumented balloon payload system, the best and poorest 2-week periods are determined. Specific examples of balloon recovery problems are presented and then solved using bivariate statistics. Author

N68-37381# National Weather Records Center, Asheville, N. C.
A COMPARISON OF RADIOSONDE TEMPERATURES AT THE 100-mb, 80-mb, 50-mb, AND 30-mb LEVELS
Harold L. Crutcher and Frank T. Quinlan Silver Spring, Md. ESSA Aug. 1968 48 p refs
(ESSA-TR-EDS-7) CFSTI: HC $3.00/MF $0.65

A comparison of radiosonde temperatures is made at three pairs of stations in the United States for the 100-, 80-, 50-, and 30-mb levels. Significance tests are applied at the 10 percent level. Inferences are drawn that observations made from selected pairs of stations 50 nautical miles apart are significantly different but that those separated by 30 nautical miles or less are not significantly different. An application to supersonic aircraft performance is indicated: the average temperature change will produce a change in supersonic aircraft speeds which will exceed seven percent of Mach 3 in 10 minutes one time in twenty. Author

N68-37389# Environmental Science Services Administration, Silver Spring, Md.
QUANTILES OF MONTHLY PRECIPITATION FOR SELECTED STATIONS IN THE CONTIGUOUS UNITED STATES
H. C. S. Thom and Ida B. Vestal Aug. 1968 42 p refs
(ESSA-TR-EDS-6) CFSTI: HC $3.00/MF $0.65

The gamma and mixed gamma distribution were fitted to 30-year monthly precipitation series for 122 first-order weather stations, using previously developed methods. Quantiles for selected probabilities from 0.02 to 0.98 are presented together with the two statistics of the gamma distribution and the mixture probability where it applies. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-36018# Department of Transportation, Washington, D. C. Communications Development Div.
A METHOD FOR ACHIEVING EQUIPMENT RELIABILITY, MAINTAINABILITY AND LOGISTICS SUPPORT Final Report
Raymond R. Barkalow 30 Aug. 1968 25 p refs
(RD-68-15)

Three basic approaches to a complete program effort are discussed. An economical, yet effective, approach to reliability is presented with suggested considerations for maintainability of equipments. The term failure rate is discussed and illustrated for use in determining spare parts requirements and possible application to a computer for logistic support. A maintenance concept is presented, based on the provisioning formula. Author

N68-36019# Airborne Instruments Lab., Deer Park, N. Y.
BEACON RANGE ALTITUDE MONITOR SYSTEM (AIRBORNE) Final Report
Lennart Hartman Aug. 1968 37 p
(Contract FA-67-WA-1648)
(RD-68-48)

The development of a feasibility model of an Airborne Range–Altitude Monitor System and the results of flight tests of the system in a Grumman Gulfstream are described. The system interrogates ATCRBS transponder-equipped aircraft within the area of interest, using a fixed beam alternating between Mode A (identification) and Mode C (altitude). The replies are processed, and those within preselected altitude limits are displayed, showing the range and identification of the nearest two aircraft. The system consists of an antenna and three black boxes: interrogator–receiver, decoder–processor, and display and control. The electronics are mostly solid state and integrated circuits that minimize size and weight. The system operates with an output power of 2 to 6 kW. The area of coverage is antenna-limited to approximately ±100 degrees in azimuth and ±20 degrees in elevation. Range is design-limited to 60 n. mi. Height layers up to ±2500 feet may be monitored, with increments of 500 feet. Flight tests proved the system feasibility and resulted in modifications that improved performance. Other improvements are indicated, which can be incorporated in production systems. Author

N68-36130# Federal Aviation Agency, Washington, D. C. Flight Standards Service.
EVALUATION OF HELICOPTER STEEL SLOPE GCA OPERATIONS
Allan W. Hunting and Russell S. Fleming May 1968 69 p

Evaluated were steep approaches flown in helicopters used for training and tactical operations in the development of precision approach procedures for rotary wing aircraft. Data were collected on: (1) Flyability of glide slope angles chosen; (2) airspeed/vertical velocity envelopes; (3) lengths of instrument approach segments; (4) location of ground point of intercept (GPI); (5) deceleration distances; (6) decision height; (7) required obstruction clearance (ROC); (8) lead fix requirements; (9) exposure time from decision height (DH) to touchdown; (10) deceleration during the descent; (11) GCA procedure techniques; (12) GCA antenna alignment changes in azimuth and elevation; and (13) comparison between stabilized and unstabilized helicopters. The maximum usable effective angle was found to be 12 degrees. Author

N68-36253# Federal Aviation Administration, Atlantic City, N. J.
LIGHTING AND MARKING OF OBSTRUCTIONS TO AIR NAVIGATION Final Report
Richard L. Sulzer Oct. 1968 34 p refs
(NA-68-45; FAA-RD-68-38)

Three classes of obstructions present hazards to VFR flight: tall towers encroach navigable airspace, catenaries obstruct the paths of low flying aircraft, and structures near airfields endanger terminal area traffic. Study of the first class, tall towers, has produced recommendations for very bright, flashing white lights and wide bands of black and white paint to enhance detection. Objection has been taken to revision of the marking standard for tall towers only, because the importance of retaining simplicity in the international standard requires all three classes of obstructions to be considered together. Additional analysis reveals that orange and white bands and checkerboards, and lesser red obstruction lights

are valuable as hazard identification signs, if detection is otherwise assured. Under marginal VFR conditions, however, there is reason to predict superior detection of both tall towers and catenaries if brightness contrast rather than color contrast is given priority. Author

N68-36364# ARINC Research Corp., Annapolis, Md.
JET FLIGHT EVALUATION OF INERTIAL NAVIGATION OPERATIONS. VOLUME 1: DISCUSSION AND RESULTS Final Report, May 1967-Jul. 1968
Jul. 1968 190 p ref Prepared jointly with United Air Lines, Inc. for Sperry Gyroscope Co.
(Contract FA-67-WA-1723)
(Publ.-558-01-1-879, v. 1; RD-68-36, v. 1; AD-673861)

This report describes the results of a jet-flight evaluation of Inertial Navigation System (INS) performance in the commercial-airline operational environment, both domestic and overwater. Evaluation objectives included (1) assessment of the compatibility of inertial techniques with the present Air Traffic Control (ATC) System, (2) determination of the relative accuracy of inertial navigation as compared with VOR/DME navigation, (3) assessment of inertial-system updating requirements, (4) evaluation of pilot-workload effects, and (5) investigation of several other aspects of the use of an inertial system in the commercial-airline environment. Author (TAB)

N68-36384* Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
APPLICATION OF STATISTICAL SMOOTHING TECHNIQUES TO INERTIAL NAVIGATION
R. K. Mehra Apr. 1968 20 p refs
(Grant NGR-22-007-068; Contract N00014-67-A-0298-0006)
(NASA-CR-97104; TR-560; AD-670004) CFSTI: $3.00 CSCL 17G

All inertial navigation systems are excited by random error inputs such as gyro drift rates, accelerometer errors etc. These errors make the position and velocity errors of the inertial navigator grow unbounded with time if no external measurements are made. Statistical smoothing techniques provide methods of estimating these random inputs from test runs of the system. (Smoothing involves estimating the state of a system at time t using measurements made both before and after time t.) In the present report, a ships inertial navigation system is considered. It is shown that by using smoothing techniques, uncertainties in the knowledge of random error sources, particularly, gyro drift rates, can be significantly reduced. Author (TAB)

N68-36595# Sandia Corp., Albuquerque, N. Mex. Aero-Thermodynamics Dept.
A TECHNIQUE FOR PREDICTING NONLINEAR WIND COMPENSATION OF BALLISTIC ROCKET SYSTEMS
G. G. Wilson Nov. 1967 20 p ref
(Contract AT(29-1)-789)
(SC-R-67-1232) CFSTI: HC $3.00/MF $0.65

Factors affecting the nonlinearities associated with wind compensation of ballistic rocket systems are discussed. A linear wind compensation method, used by Sandia Laboratory since 1959, is presented and extended to account for nonlinear effects. Comparisons between the two methods are made to show expected improvements in accuracy. Author (NSA)

N68-36832# Federal Aviation Administration, Atlantic City, N. J.
EVALUATION OF LOW-COST COLLISION AVOIDANCE GROUND TRAINING EQUIPMENT Final Report
Richard L. Sulzer and Warren G. Crook Nov. 1968 31 p refs
(NA-68-37; DS-68-22)

The purpose of this project was to determine the effectiveness of a system of low cost aids in improving visual search and in providing practice in search technique during simulated cross-country flight. Twelve private/commercial and three student pilots having widely varied amounts of flight time were given practice in dividing their time between in-cockpit flight duties and external visual search. This "time-sharing" practice was conducted in a general aviation-type ground trainer using low-cost slide equipment to project images of intruder aircraft on possible collision courses. Results indicate marked improvement in target detection throughout the 10 sessions flown, with no corresponding deterioration of flight control performance or detection of instrument warnings. Further measurement of the development of time-sharing skills, using similar low-cost ground training equipment, is recommended at an approved flight school to validate the concept. Author

N68-36871# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
TEST AND EVALUATION OF OVER-OCEAN SEPARATION ASSURANCE SYSTEMS Final Report
Anthony D. Bradley and Ronald S. Bassford Sep. 1968 120 p refs
(NA-68-38; RD-68-47)

Three airborne air-to-air ranging systems were evaluated to determine their capability to provide aircraft separation information in an over-ocean airspace environment, and to verify the technical characteristics of each system. The systems evaluated were: (1) TACAN Navigational Set AN/ARN-52(v); (2) Airborne Beacon Range/Altitude Monitor; and (3) Airborne Time/Frequency Range/Altitude Monitor. Flight tests confirmed the results obtained during the simulation effort which established the operational procedures for each system. The technical tests indicated that all three systems were suitable for operation in an over-ocean environment, but improvement should be made in the antenna coverage of the Airborne Beacon Range/Altitude Monitor and the synchronization of the Airborne Time/Frequency Range/Altitude Monitor employing a dual antenna feed configuration. Author

N68-37247# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugmechanik.
A METHOD FOR THE COMPUTATION OF PROBABILITY INTEGRALS OF MULTI-DIMENSIONAL DISTRIBUTIONS [EIN VERFAHREN ZUR BERECHUNG VON WAHRSCHEINLICHKEITSINTEGRALEN MEHRDIMENSIONALAR VERTEILUNGEN]
Bernadette Gruenhage Jul. 1968 28 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-44) CFSTI: HC $3.00/MF $0.65

The common covariance matrix of the n aiming errors of a series of n shots in an m-dimensional space (m = 2 or 3) is calculated for the case that the aiming error for each shot is a function of the first aiming error. Each element of the covariance 2matrix is an nm-fold Stieltjes-Integral. It is shown that this nm-fold Stieltjes integral may be reduced to an m-fold Riemann integral if the probability distribution of the first aiming error has a density function. In the special case that each aiming error is a linear function of the first one, the covariance matrix is a linear function of the covariance matrix of the first aiming error. As an example, in two cases the hit probability of a series of five shots is calculated against a target approaching directly for different distances and a 50 per cent total dispersion of 4 $^{-}$. In the first case it is assumed that from shot to shot the aiming errors as well as the ballistic errors are uncorrelated, and in the second case that the aiming errors are correlated and the ballistics errors still uncorrelated. In both cases for each shot the aiming error and the ballistic error are assumed to be independent of each other. Author

N68-37402*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL ANALYSIS AND INTEGRATION
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 48-52 (See N68-37397 23-11)

Guidance and control analysis and integration studies which focus on (1) the automation of variational techniques for the solution of optimum control problems; (2) demonstrating optical approach-guidance flight feasibility; and (3) developing computer-oriented operational support equipment; are summarized. Two computer programs, DEVNEC and QUASI, for completely automating the solution of optimal control problems where the computation scheme assumes small scale variations about a nominal solution; are described. The first program DEVNEC uses the system equations and the boundary conditions as inputs to derive all of the necessary conditions for an optimum solution by use of the maximum principle. The second program automates a generalized Newton-Raphson method for the solution of two-point boundary value problems. Onboard sources of optical data that are under consideration for possible use in Mars-encounter earth-based orbit determination include the following: the far encounter planet sensor, the scan platform, the attitude control celestial sensors, and the TV system. Studies have shown the usefulness of TV data in the orbit determination process when Mars is in a TV frame. An OSE (operational support equipment) unified approach concept was developed which is to be applied to the three guidance and control flight subsystems (electrical power, guidance and control, and central computer and sequencer) to provide an integrated approach to subsystem testing in the laboratory, manufacturing area, system test complex, and launch complex is described. Included are discussions of hardware and software functions. S.C.W.

N68-37403*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 53-71 refs (See N68-37397 23-11) 23-11)
CSCL 17G

Spacecraft control research is reported which focuses on (1) the development of long-life rate-integrating gas bearing gyros that will be capable of withstanding both thermal and gas sterilization without significant degradation of performance, and which have potential applications in both advanced spacecraft and entry capsule attitude control systems; (2) computer simulation and analysis studies of ion thruster control loops suitable for use as primary propulsion of a spacecraft for deep space missions (such as a Jupiter flyby); (3) studies of the attitude control of an electric-propulsion-powered (ion engine) vehicle during the powered flight phase which are directly applicable to an advanced technical studies task related to a solar electric-powered spacecraft mission to Jupiter; studies of spacecraft antenna pointing systems for a multiple-planet mission, as for example, a gravity assist mission (Grand Tour) to the Jovian planets (Jupiter, Saturn, Uranus, and Neptune); and (4) extended mission control systems development studies of attitude control configurations for vehicles utilizing electric propulsion systems, more specifically, Jupiter spacecraft. S.C.W.

N68-37404*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 72-80 refs (See N68-37397 23-11)

Guidance and control research is reported which focuses on studies of (1) Josephson junction memory elements and their applicability on board spacecraft; (2) the frequency response of thin film thermal detectors to radiant energy; (3) the GaSe Schottky barrier gate and its applicability in the construction of field effect devices; (4) the concept of photoconductive gain and the general model of blocking contacts on lightly doped semiconductors, and methods for determining the potential barrier height of a metal-semiconductor contact; (5) pre-ignition characteristics of cesium thermionic diodes; and (6) the switching feasibility of the thermionic diode. S.C.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-36055*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH POWER KINETICS OF A TWO DIMENSIONAL CIRCULATING LIQUID METAL FUEL REACTOR
Michael J. Kolar Washington Oct. 1968 54 p refs
(NASA-TN-D-4840) CFSTI: HC $3.00/MF $0.65 CSCL 18K

A two dimensional model of a single channel unreflected circulating fuel reactor is used to investigate the effect of a radial temperature distribution on the neutron kinetics. A slug flow model with no delayed neutrons is used. The effects of a nonuniform radial heat source distribution and radial heat transfer are taken into account. Results show that radial heat transfer has little effect on the kinetics. Furthermore, if changes in multiplication are not too large, the flux and radial temperature distribution maintain their steady state shapes throughout the transient. For certain combinations of the physical parameters, resonances can occur in the time dependent flux and temperature. These resonances can be predicted by either a line reactor model or a two dimensional reactor model; however, a two dimensional model is necessary to predict the value of the steady state flux and temperature following a transient. Author

N68-36085 Rensselaer Polytechnic Inst., Troy, N. Y.
DISTRIBUTED PARAMETER OPTIMUM CONTROL OF A NUCLEAR ROCKET WITH THERMAL STRESS CONSTRAINTS
David Lawrence Briggs (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-815

The problem considered is that of programming minimum time, coolant flow transients through a nuclear rocket such that temperature gradients in the fuel elements, and the corresponding thermal stresses produced, do not exceed tolerable values. A distributed parameter thermal and stress model is used for the solid fuel element nuclear rocket. The problem is formulated as a distributed parameter optimal control problem. The state equations are a pair of coupled, bilinear, partial differential equations, and the thermal stress limitation forms an inequality constraint which is a function of both the state and the control variables. This constraint is required to apply at all points in space and time. The initial conditions are taken as steady state, and the terminal condition that the coolant flow obtain a fixed higher level may be interpreted as an inequality condition on the terminal states. Dissert. Abstr.

N68-36100*# Gulf General Atomic, San Diego, Calif.
FUEL AND FISSION PRODUCT TRANSPORT THROUGH CHEMICALLY VAPOR-DEPOSITED FLUORIDE TUNGSTEN
L. Yang and R. G. Hudson 17 May 1968 16 p refs Presented at the 2d Intern. Conf. on Thermionic Elec. Power Generation, Stresa, Italy, 27-31 May 1968
(Contracts NAS3-6471; NAS3-8504)
(NASA-CR-97118; GA-8655) CFSTI: HC $3.00/MF $0.65 CSCL 18J

The transport rates of fuel components from 90UC–10ZrC, UO_2 and W-80 vol% UO_2 cermet through chemically vapor-deposited fluoride tungsten cladding were determined in the temperature range 1923–2273°K, using samples of both planar and cylindrical configurations. From the results obtained, it is estimated that the total amount of uranium transported through 40 mil thick fluoride tungsten cladding in 10,000 hours may vary from a few to 5000 monolayers, depending upon fuel composition, fuel stoichiometry and temperature. The uranium transport rate of UO_2 through fluoride tungsten cladding at 2273°K is many orders of magnitude higher than that reported for powder metallurgy or arc-cast tungsten cladding at the same temperature, implying the importance of cladding structure to uranium transport rate. It is shown that the carbon transport through fluoride tungsten cladding will not cause a significant change in fuel stoichiometry at 2037°K in 10,000 hours. Author

N68-36162# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Development Center.

POST-IRRADIATION EXAMINATION OF THORIA-URANIA FUEL RODS Quarterly Progress Report, Sep.–Nov. 1967

W. N. Bishop and S. F. Marsh Jun. 1968 23 p refs

(Contract AT(30-1)-3809)

(BAW-3809-2; QPR-2) CFSTI: HC $3.00/MF $0.65

The fuel rods for this program were removed from the fuel elements at Battelle Memorial Institute and transported to the Babcock & Wilcox Nuclear Development Center. Most of the rods were gamma scanned. A sequential chemical separation procedure for uranium, plutonium, americium–curium, cesium, neodymiun, phomethium, and samarium was refined and is considered ready for use on thoria–urania fuels. This procedure uses four columns; two extraction chromatography columns and two inorganic ion exchange columns, for separation of the elements. Two separation procedures for neptunium were evaluated and a solvent extraction procedure was selected for this program. Author (NSA)

N68-36231# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

NOVA: A MODULAR PROGRAM SYSTEM FOR REACTOR PHYSICS STUDIES

M. Lubert, B. F. Schunicht, and E. E. Kazmierczak 12 Jun. 1968 8 p Presented at the 14th Ann. Meeting of the Am. Nucl. Soc., Toronto

(Contract W-31-109-ENG-52)

(KAPL-P-3431; CONF-680601-26) CFSTI: HC $3.00/MF $0.65

The NOVA computer system is described; this system is a collection of reactor physics, mathematics, engineering, and data reduction modules. The NOVA system consists of about 150 Fortran modules, and is structured for user/computer interaction optimization. A list of problems, for which the NOVA system can be used, is given. Problems concountered with the NOVA format are discussed. NSA

N68-36234# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

APPLICATION OF MONTE CARLO METHODS IN REACTOR PHYSICS

M. R. Mendelson [1968] 26 p Presented at the 14th Ann. Meeting of the Am. Nucl. Soc., Toronto

(Contract W-31-109-ENG-52)

(KAPL-P-3432; CONF-680601-27) CFSTI: HC $3.00/MF $0.65

General descriptions of the DRAM and MORSE Monte Carlo codes are given; code capabilities for problem solving are tabulated. Monte Carlo applications to reactor physics calculations are described. Use of Monte Carlo techniques for checking analytic methods is discussed; the simulation of experimental configurations is described; use of Monte Carlo methods in analysis of basic nuclear data is evaluated. Calculation of criticality of thermal reactors is shown as a function of generation number; comparisons of measured-to-calculated values for neutron absorption in ^{10}B-poisoned reactor fuel elements are tabulated. NSA

N68-36295# Douglas United Nuclear, Inc., Richland, Wash.

RELIABILITY ANALYSIS OF NUCLEAR REACTOR ELECTRONIC SYSTEMS

R. A. Rohrbacher 17 Jun. 1968 38 p refs Presented at the Western Electronic Show and Convention Conf., Los Angeles

(Contract AT(45-1)-1857)

(DUN-SA-66; CONF-680803-2) CFSTI: HC $3.00/MF $0.65

Reliability estimates and predictions of electronic systems in nuclear reactors are considered in reactor design. The reliability of a component device, or system is the successful performance for a specified period of time under certain conditions. Reliability evaluation, theory, failure sequence analysis, and effect analysis are discussed. Reliability models are presented and a fault tree analysis used at Hanford is given. NSA

N68-36481# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

DISTRIBUTION OF FLUID VELOCITIES FOR RANDOMLY PACKED BEDS IN SPHERES

J. Price 1967 9 p refs Presented at the Conf. on Thermodyn. and Fluid Mech., Brisbane

(CONF-671211-1)

Fluid velocity distributions in randomly packed beds are of interest in the design of heat and mass transfer systems, including pebble bed nuclear reactors. The literature is briefly reviewed. Discrepancies exist in the data for similar beds and attention is drawn to the limitations of theoretical solutions. The methods of measurement used by previous investigators are appraised. Measurements of the fluid velocity distributions are presented for a number of randomly packed beds of spheres. A honeycomb was placed between the exit face of the bed and the plane of measurement. The results shows that a region of high velocity existed within one-half sphere diameter from the walls of the containing vessel and that over the rest of the bed the departures from uniformity were small. The distribution was independent of Reynolds number and bed length. Slight systematic effects were observed near the walls due to the packing method, sphere properties, and vessel to sphere diameter ratio. The results differ substantially from those of previous investigators whose measurements were made at exit from the bed. They are in accord with measurements made inside the bed. Author (NSA)

N68-36541# Production Group, United Kindgom Atomic Energy Authority, Sellafield (England).

A METHOD FOR THE SEPARATE COLLECTION OF KRYPTON AND XENON FROM REACTOR COOLANT GAS IN PREPARATION FOR GAMMA SPECTROMETRIC COUNTING

R. L. D. French 1967 9 p

(PG-807) CFSTI: HC $3.00/MF $0.65

The reactor coolant CO_2 is first bubbled through KOH solution. Separation of the Kr and Xe is achieved by passing a sample of the residual gas so obtained through two charcoal-filled traps cooled by liquid N_2 and solid CO_2, respectively. The traps may then be counted directly for Kr and Xe. Any Ar present is not retained by the traps, the design of which is described. NSA

N68-36599# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
MODIFICATION OF THE BYPASS CHANNEL RELATIVE TO INCREASING POWER OF THE TRIGA REACTOR TO 1 MW [MODALITA DI ESECUZIONE DEL CANALE PASSANTE RELATIVO AL PROGRAMMA PER L'AUMENTO DI POTENZA DEL REATTORE TRIGA AD 1MW]
G. Florita 1966 63 p In ITALIAN
(RT/ING-(66)26)

A tangential bypass channel was constructed for low γ background studies. The topographic procedures for locating the channel are described. The construction of the channel is then described and illustrated. NSA

N68-36600# California Univ., Livermore. Lawrence Radiation Lab.
CONTRIBUTION TO THE 25TH MEETING OF THE HIGH-TEMPERATURE FUELS COMMITTEE, PART 1
A. J. Rothman, comp. 25 Oct. 1967 31 p refs Meeting held at San Diego, 5–7 Dec. 1967
(Contract W-7405-ENG-48)
(UCID-15238(Pt. 1); CONF-671206-1) CFSTI: HC$3.00/MF$0.65

Uranium nitride heated in nitrogen at 1950°C and at an estimated pressure of 20 atm for 24 hours showed anomalously large grain growth. The technique was used to grow large single crystals, but the results were not reproducible from sample to sample. The diffusion coefficient of nitrogen in uranium nitride appears to decrease appreciably with decreasing nitrogen pressure. About a five-fold reduction in the diffusion coefficient results from a change in nitrogen pressure from 110 to 7 torr. A capsule to irradiate uranium nitride having various microstructures at 1500°C is being fabricated. Calculations have been made for nitrogen balances in fissioning uranium nitride at various temperatures and nitrogen pressures. About 17 atoms of free nitrogen become available for each 100 atoms of uranium fissioned under most conditions at 1500 to 2500°K, and various nitrogen pressures from 10^{-6} to 1 atm. Improved solubility measurements of tungsten in liquid silver are 1.2 ppM at 2380°C, and 0.7 ppM at 2200°C. Author (NSA)

N68-36615*# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL STUDY OF MULTI-COMPONENT COAXIAL-FLOW JETS IN SHORT CHAMBERS
Bruce V. Johnson Washington NASA Oct. 1968 84 p refs
(Contract NASw-847)
(NASA-CR-1190; G-910091-16) CFSTI: HC $3.00/MF $0.65
CSCL 21F

Fluid mechanics experiments were performed to obtain information applicable to an open cycle, coaxial flow, gaseous nuclear rocket engine. In this engine concept, gaseous nuclear fuel and a surrounding stream of seeded hydrogen propellant pass coaxially through a reactor chamber. The flow was simulated in the present experiments by multicomponent, constant temperature, coaxial flow jets in short chambers. The flow was studied using flow visualization techniques and concentration measurements. Author

N68-36659# Soreq Research Establishment, Israel Atomic Energy Commission, Rehovoth. Nuclear Research Center.
RESEARCH LABORATORIES ANNUAL REPORT, JANUARY–DECEMBER 1966
Jul. 1967 263 p
(IA-1128)

Brief summaries are presented on the numerous research projects which were conducted in the areas of reactors and reactor physics, nuclear physics, and solid state physics and metallurgy; nuclear chemistry, radiation chemistry, and inorganic chemistry; biology and medicine; environmental studies and measurements of radioactive fallout; radioisotope applications, and irradiation of agricultural products; electronic equipment and measuring instruments; and production of radioisotopes and labelled pharmaceuticals including ^{131}I, ^{131}I-labelled triolein and oleic acid, and radioiodinated serum albumin and albumin macroaggregates. Among the specific projects reported are (1) medical research on the detection of radiation exposure by fluorescent microscopy of human blood cells; (2) basic nuclear data for high plutonium isotopes and for fast reactor calculations; (3) resonance scattering of neutron-capture gamma rays, and the Mossbauer effect using capture gamma rays; (4) Mossbauer spectroscopy; (5) activitation analyses; and (6) radiolysis, and linear energy transfer effects. Author and subject indexes are included, along with a report bibliography. M.G.J.

N68-36717# Sandia Corp., Albuquerque, N. Mex.
AMSA FUEL CAPSULE IMPACT TESTS
W. J. Dalby Aug. 1967 163 p refs
(SC-DR-67-718) CFSTI: HC $3.00/MF $0.65

A three-phase program was conducted to evaluate the impact resistance of the fuel capsule for the AMSA application. The fuel capsule may reasonably be expected to provide fuel containment under all except the most adverse conditions. Impacting the bare capsule at 185 to 200 percent of the experimentally determined sea level equilibrium velocity of approximately 340 ft/sec into soil and concrete targets did not appear to significantly impair the fuel containment capability of the capsule. Impacting the bare capsule into a rigid target (granite) at velocities as low as 85 percent of the experimentally determined sea level equilibrium velocity of 340 ft/sec, with the cylindrical axis of the capsule at 35 to 55 degrees with the normal to the target face and the velocity vector normal to the target face, ruptured the capsule. Author (NSA)

N68-36726# Atomics International, Canoga Park, Calif.
FISSION EFFECTS IN METAL FUELS Final Report
A. I. Anderman, W. G. Gehman, J. J. Holmes, and A. H. Willis 25 Mar. 1968 48 p refs
(Contract AT(04-3)-701)
(NAA-SR-12549) CFSTI: HC $3.00/MF $0.65

Samples of heat-treated U–4 wt % Mo and U–10 wt % Mo alloys, with and without ternary additions, were irradiated to 0.8 and 1.4 at.% burnup at temperatures of 550° and 645°C. In general, uranium alloys without molybdenum performed poorly under these irradiation conditions. Selected specimens of U–Mo–Si exhibited similar very low volume increases at 0.5 at.%-burnup and 435 to 510°C. The mechanism of rare gas-atom migration and trapping was studied in lightly irradiated copper foils by measuring gas release during subsequent annealing. The kinetics of gas release were found to be nondiffusional, and the total amount of gas released was always a small fraction of the total gas content. The effect of fission during proton irradiation on the creep of thorium, at temperatures of 273° to 473°K, was measured. Fission was found to induce creep at stresses where none would occur in the absence of fission, and this creep appeared to be athermal. A computer investigation of some fundamental atomic characteristics relevant to fuel swelling phenomena has been performed. The primary focus was the study of the formation energies and lattice strain fields of small xenon-vacancy clusters in a copper matrix. Author (NSA)

N68-36735# Oak Ridge National Lab., Tenn.
GENGTC: A ONE-DIMENSIONAL CEIR COMPUTER PROGRAM FOR CAPSULE TEMPERATURE CALCULATIONS IN CYLINDRICAL GEOMETRY
Hall C. Roland Dec. 1967 19 p
(Contract W-7450-ENG-26)
(ORNL-TM-1942) CFSTI: HC $3.00/MF $0.65

An analysis has been made and a generalized computer program in BASIC language is presented for one dimensional radial

heat transfer calculations in cylindrical geometry. Provision is made for fission heat, gamma heat, multiple solid radiation shields, liquid filled annuli and gas filled annuli. Radiation heat transfer across gas filled annuli is included. Correction is made for variation of thermal conductivities with temperature and for changes in dimensions due to thermal expansion. Author (NSA)

N68-36756# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PHOENIX FUEL PROGRAM Progress Report
D. D. Lanning, ed. and G. J. Busselman, ed. Nov. 1967 132 p refs
(Contract AT(45-1)-1830)
(BNWL-635)

Reactor fuels, reactor control elements, and several reactors were studied during the Phoenix fuel program. Neutronics characteristics of Phoenix, reactivity calculations for Phoenix marine reactors, and use and economics of plutonium as a fuel were considered. Phoenix fuel reloading, lattice characteristics, criticality calculations, and core lifetime for Phoenix fuels were studied in relation to the Plutonium Recycle Test Reactor; and power distribution in Phoenix fuel elements was studied for the plutonium recycle critical assembly. Phoenix fuel elements for the Materials Testing Reactor were considered, as were aspects of fuel loading, thermal hydraulics, and core parameters for the reactor. NSA

N68-36781# Bettis Atomic Power Lab., West Mifflin, Pa.
PROBLEMS IN CRITICAL CALCULATIONS FOR SMALL REACTORS (ANALYSIS OF THE JRR-4)
Shoichiro Nakamura and Takahiro Morita [1968] 28 p refs
Transl. into ENGLISH from Hitachi Hyoron (Japan), no. 48, 1966 p 27-32
(WAPD-TRANS-85) CFSTI: HC $3.00/MF $0.65

Critical calculations for nuclear reactors generally require high precision. On the other hand, the methods of calculation include many assumptions, and large errors can result from the choice and application of these assumptions. Some of the major problems in small reactors are the errors that can result from how the leakage in the vertical direction is treated, how the gross constants of fast neutrons are treated, and the construction of the core elements. These problems are examined using measurements made with the swimming pool reactor of the Japan Atomic Energy Research Institute and the limits of error are determined. It has been shown that the critical conditions of small reactors of this type can be calculated with a high degree of precision using the results of these critical calculations. Author (NSA)

N68-36808# Oak Ridge National Lab., Tenn.
REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME 2: RADIATION SAFETY AND CONTROL
R. A. Costner, Jr., E. N. Cramer, and R. L. Scott, Jr. Jan. 1968 181 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2034, v. 2) CFSTI: HC $3.00/MF $0.65

One of five reactor operator training handbooks is presented. The five volumes include, Vol. I—Elementary Mathematics Review, Vol. II—Radiation Safety and Control, Vol. III—Reactor Physics, Vol. IV—Heat Theory and Fluid Flow, Vol. V—Instrumentation and Controls. The method of instruction is explained at the beginning of each volume. This volume covers instruction sections on Atoms, Radioactive Material and Radiation, Ionization, Radiation Units, Health Hazards of Radiation, Radiation Protection Methods, and Radioactive Contamination—Protective Measures. NSA

N68-36809# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ASSEMBLY, WELDING, AND TESTING OPERATIONS FOR MANUFACTURE OF FUEL ELEMENTS FOR THE ZERO POWER PLUTONIUM REACTOR
S. Siemion and D. F. Livesay 19 Jan. 1968 14 p refs
(Contract AT(29-1)-1106)
(RFP-1078) CFSTI: HC $3.00/MF $0.65

Equipment and procedures used in cleaning, assembling, welding, and testing of stainless steel jacketed, rectangular core, fuel elements for the Zero Power Plutonium Reactor are described. NSA

N68-36841# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ESTIMATION OF WEIBULL PARAMETERS FROM FAILURE DATA
John L. Jaech 12 Jun. 1968 15 p refs Presented at the Ann. Meeting of the Am. Statist. Assoc., Pittsburgh, 20-23 Aug. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1920; CONF-680807-1) CFSTI: HC $3.00/MF $0.65

Reactor fuel element failure data, which is used for determination of parameters for the Weibull density function, are tabulated. Use of a non-parametric estimation of failure rate is discussed. A method for estimation of Weibull parameters is proposed; uncertainty limits are evaluated. A numerical example is given. NSA

N68-36872# Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany).
EXPERIMENTS TO EVALUATE REACTIVITY COEFFICIENTS WITH REACTOR OPERATING AT STEADY STATE CONDITIONS (STATIC EXPERIMENTS)
L. Caldarola, W. Haefele, and W. Schikarski ENRATOM 1966 40 p refs
(Contract EURATOM-009-63-1 RAAD)
(EUR-3013.E)

The experiments to evaluate reactivity coefficients with reactor operating a steady state conditions are described. Three reactivity coefficients are defined: the global power coefficient, G, referred to the reactor power; the global coolant temperature coefficient, γ, referred to the average coolant temperature; the secondary radial expansion temperature coefficient, γ_r, referred to the coolant temperature rise in the reactor. Each coefficient is measured by a separate experiment in which the reactivity effects due to the other two are made equal to zero. The error analysis is developed with numerical examples referred to the Southwest Experimental Fast Oxide Reactor (SEFOR). With the aim of minimizing the total error, attention is given to the choice of the best power interval for the measurement of the global power coefficient. The control philosophy of the reactor system during the experiments is also studied. Author (NSA)

N68-36875# Oak Ridge National Lab., Tenn.
SEVERE RADIATION DAMAGE TO ALUMINUM ALLOYS
J. E. Cunningham, comp. Mar. 1968 52 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2138) CFSTI: HC $3.00/MF $0.65

Malfunction of core components in the Oak Ridge Research Reactor owing to excessive bowing and the unexpected failure of transuranium target rods that leaked radioactivity into the coolant system of the High Flux Isotope Reactor have been traced to severe radiation damage to aluminum alloys. The gross structural damage observed is accompanied by drastic alteration of mechanical properties and the formation of about 10^{15} cavities/cm^3. The cavities give rise to swelling in the material. Pre- and postirradiation data that delineate radiation embrittlement and a striking loss in total

strain before fracture on 1100, 6061-T6, and X8001 aluminum alloys are presented and discussed. Preliminary results on the influence of cyclotron-injected helium to a level of 5 at. ppM on the mechanical behavior of the same alloys in the annealed condition and hot-rolled SAP 895 are described and compared with effects induced by reactor irradiation. Potential damage mechanisms are reviewed, and the need for further study under well-controlled and analyzable conditions is stressed. Author (NSA)

N68-36890# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.

USE OF A MOMENTS METHOD FOR THE ANALYSIS OF FLUX DISTRIBUTIONS IN SUBCRITICAL ASSEMBLIES

H. S. Cheng, I. Kaplan, T. J. Thompson, and M. J. Driscoll Feb. 1968 353 p refs

(Contract AT(30-1)-2344)

(MIT-2344-11; MITNE-84) CFSTI: HC $3.00/MF $0.65

A moments method has been developed for the analysis of flux distributions in subcritical neutron-multiplying assemblies. The method determines values of the asymptotic axial and radial buckling, and of the extrapolated height and radius from foil activation data in terms of flux moments defined in the usual sense. Analytic expressions are derived for the axial and radial buckling and extrapolated dimensions in terms of the flux moments. These expressions have clear physical meaning and are suitable for the interpretation of conventional buckling measurements. The method treats the moment index as a variable parameter and allows freedom in the choice of the locations of the first and last data points used in the analysis. These degrees of freedom make it possible to reduce the effects of source neutrons, flux transients, and higher harmonics. As a result, the moments method can be applied successfully to very small lattices as well as to large exponential assemblies. Author (NSA)

N68-36895# Brookhaven National Lab., Upton, N. Y.

NUCLEAR ENGINEERING DEPARTMENT Annual Report

31 Dec. 1967 196 p refs

(BNL-50082) CFSTI: HC $3.00/MF $0.65

Activities of the BNL Nuclear Engineering Department in fundamental reactor physics, chemistry, and metallurgy studies, component development for reactor technology and radiation application, and engineering and evaluation studies are reviewed. NSA

N68-36909# Argonne National Lab., Ill.

IRRADIATION PERFORMANCE OF URANIUM-PLUTONIUM CARBIDE FUELS: THE USA EXPERIENCE

A. A. Strasser (United Nucl. Corp., Elmsford, N. Y.) and J. H. Kittel 17 Jun. 1968 34 p refs Presented at the AIME Nucl. Met. Symp. on Plutonium Fuels Tech., Phoenix, Ariz., 4–6 Oct. 1967

(CONF-671005-7) CFSTI: HC $3.00/MF $0.65

Irradiation experience with uranium-plutonium carbides is presented, and their performance potential is evaluated. Uranium-plutonium carbides have been irradiated in the form of high-density pellets to 114,000 MWd/t, low-density pellets to 18,000 MWd/t, and vibratory compacted particles to 62,000 MWd/t at powers up to 330 W/g, 260 W/g, and 470 W/g, respectively, in thermal and fast reactors. The fuel performed without significant microstructural changes, and plutonium redistribution or fission product segregation did not occur. The thermodynamic compatibility of the carbides with stainless steel, niobium, and vanadium clads was excellent up to 10,600 hr of operation. Small fission gas voids formed in the center of the rods at the higher powers. Sintering of vibratory compacted material occurred in solid solution material at 950 W/cm (29 kW/ft), but not in physically mixed particles at 820 W/cm. Author (NSA)

N68-36928*# Gulf General Atomic, San Diego, Calif.

THERMIONIC REACTORS FOR ELECTRIC PROPULSION: PARAMETRIC STUDIES

W. G. Homeyer, C. A. Heath, and A. J. Gietzen 20 May 1968 20 p refs Presented at the 2d Intern. Conf. on Thermionic Elec. Power Generation, Stresa, Italy, 27–31 May 1967 Submitted for publication

(Contracts NAS3-6471; AT(04-3)-167)

(NASA-CR-97257; GA-8390) CFSTI: HC $3.00/MF $0.65 CSCL 18L

In-core nuclear thermionic power plants consist of a reactor containing thermionic cells, a nuclear radiation shield, a heat rejection system, and electrical transmission lines and power conditioning equipment. The influence of design parameters on size, mass, and reliability is evaluated over a range in power output from tens of kilowatts to several megawatts. Methods of achieving high reliability with a minimum sacrifice in size and mass are described. The importance of the multiplicity of components and their manner of connection is evaluated. Major parameters of the reactor include the emitter and collector temperatures and electrical power density, and emitter size, the nuclear fuel fraction, and the fissile nuclide. The parameters affecting the shadow-shield mass include the cone angle, the dose rate allowable, and the distance between the reactor and the region to be shielded. Author (NSA)

N68-36974# Bettis Atomic Power Lab., Pittsburgh, Pa.

CALCULATIONAL METHOD FOR THERMAL DISADVANTAGE FACTOR (LWB-LSBR DEVELOPMENT PROGRAM)

A. J. Buslik Sep. 1967 20 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-672) CFSTI: HC $3.00/MF $0.65

A rapid method of calculation of the thermal disadvantage factor for a lattice cell consisting of a fuel rod, clad, and water is presented. The method permits representation of the actual cell geometry and includes the effects of spectral hardening in the fuel. It consists of a series on one-energy spatial calculations using the Sauer method followed by a homogeneous spectral calculation. Numerical comparisons between this calculational method and much more elaborate 36-multigroup Monte Carlo calculations are made, and good agreement is obtained. Author (NSA)

N68-37011# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

TRANSIENT IRRADIATION EXPERIMENTS WITH VIBRATIONALLY COMPACTED UO_2 FUEL RODS IN TREAT

R. L. Gulley, D. R. Armstrong (Argonne Natl. Lab.), and L. J. Harrison (Argonne Natl. Lab.) 4 Jun. 1968 14 p refs Presented at the 14th Ann. Meeting of the Am. Nucl. Soc., Toronto

(Contract AT(45-1)-1830)

(BNWL-SA-1674; CONF-680601-22) CFSTI: HC $3.00/MF $0.65

Behavior of Zircaloy-2 clad, vibrationally compacted UO_2 fuel rods under transient radiation in the Transient Reactor Test Facility (TREAT) is reported. NSA

N68-37044# New Mexico Univ., Albuquerque. Dept. of Nuclear Engineering.

REACTIVITY CONTRIBUTIONS IN THE GLORY HOLE OF THE SANDIA PULSED REACTOR 2

Robert L. Long May 1968 30 p refs Prepared for Sandia Corp.

(Contract AT(29-1)-789)

(SC-CR-68-3571) CFSTI: HC $3.00/MF $0.65

Reactivity worths of various materials are measured as a function of position in the glory hole of the Sandia Pulsed Reactor II (SPR II). Negative reactivity effects are discussed. Effects of glory hole samples on burst behavior are also discussed. NSA

N68-37118# IIT Research Inst., Chicago, Ill. Technology Center.
STUDIES OF REACTOR CONTAINMENT Bimonthly Progress Report, 1 Oct.–30 Nov. 1967
E. V. Gallagher 30 Nov. 1967 21 p refs
(Contract AT(11-1)-578)
(IITRI-578-P-21-35) CFSTI: HC $3.00/MF $0.65

Results of shock tube blowdown tests using twelve-foot-long driver sections are given. Effects of flow are analyzed; data are shown graphically. Driver cross section geometries are given. NSA

N68-37170# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
GAMMA HEATING CALCULATIONS IN GRAPHITE MODERATED SYSTEMS
G. E. Hanson and G. J. Busselman 1 Nov. 1967 20 p refs
(Contract AT(45-1)-1830)
(BNWL-625) CFSTI: HC $3.00/MF $0.65

Calculations were carried out to determine the amount of fission product gamma ray energy absorbed in various regions of a tubular fuel element and the surrounding graphite of a unit cell. Two different methods were used, involving two separate computer codes; a point-kernel shielding code and a transport code. Several approximations of the annular fuel element were used in the shielding code. Results from the two methods are compared and discussed, and the best approximation using the simpler shielding code is determined. Author (NSA)

N68-37174# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
USER'S MANUAL FOR THE FORTRAN VERSION OF RSAC: A RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM
L. C. Richardson Jun. 1968 140 p refs
(Contract AT(10-1)-205)
(IDO-17261) CFSTI: HC $3.00/MF $0.65

This report constitutes a user's manual for the FORTRAN version of the RSAC computer code. The mathematical model and equations are described. The program computes the potential radiological doses resulting from either a continuous or instantaneous release of radioactive fission products to the atmosphere. The doses considered are cloud gamma, deposition gamma, ingestion, and inhalation and are based upon the release of up to 450 isotopes, the relative abundance of each isotope being dependent upon the operating history of the nuclear reactor under consideration. NSA

N68-37187# Gulf General Atomic, San Diego, Calif.
TEMPERATURE AND POWER COEFFICIENT MEASUREMENT DURING RISE TO POWER IN PEACH BOTTOM (RESULTS OF POST CONSTRUCTION R AND D PROCEDURES DP-2, DP-3, DP-4, GP-2, AND GP-9)
J. R. Brown and K. R. Van Howe 11 Apr. 1968 15 p refs
(Contract AT(04-3)-314)
(GAMD-7909) CFSTI: HC $3.00/MF $0.65

Core reactivity changes resulting from changes in core temperature or in core power or combinations of both are presented for the Peach Bottom Power Reactor, Unit 1 during the rise to power program from January to June 1967. Core reactivity changes are determined from measured position changes of calibrated control rods; core temperatures are obtained from fuel element thermocouples; the helium flow rate and helium temperature are obtained from the standard plant instrumentation; and the core power is obtained from nuclear instrumentation calibrated by heat balance data. The measurements are compared with calculations. Author (NSA)

N68-37209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VERY HIGH BURNUP VAPOR TRANSPORT FUEL PIN CONCEPT FOR LONG LIFE NUCLEAR REACTORS
Frank E. Rom, Patrick M. Finnegan, and Glen E. McDonald Washington Oct. 1968 33 p refs
(NASA-TN-D-4860) CFSTI: HC $3.00/MF $0.65 CSCL 18I

A very-high-burnup, vapor-transport fuel-pin concept is presented. Sample calculations using the design charts given in the report show that fission densities in the range of 10^{20} to 10^{21} fissions per cubic centimeter are conservatively predicted. The fuel within the pin can be operated at sufficiently high inside surface temperatures so that fuel redistribution will occur by design. This feature accommodates and relieves the adverse effects of nonuniform power distribution, hot spots, and nonuniform burnup. Changes in reactor reactivity due to high burnup are minimized with the vapor-transport fuel-pin concept. Author

N68-37222# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.
FAST REACTOR MIXED CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM Quarterly Progress Report, Oct.–Dec. 1967
10 Feb. 1968 41 p refs
(Contract AT(30-1)-3415)
(UNC-5201; QPR-2) CFSTI: HC $3.00/MF $0.65

A description is given of uranium carbide and plutonium carbide fuel element irradiation during October through December, 1967 using the experimental Breeder Reactor 2. Analyses of fast neutron radiation effects on physical properties of various metal-clad fuel elements are presented as well as liquid sodium fuel bonding studies. Vanadium and vanadium alloys, stainless steel, and Incoloy 800 cladding materials were tested. NSA

N68-37260*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAMMA HEATING IN THIN HEAVY-ELEMENT ABSORBERS
John H. Lynch, Richard J. Crum, and Harry J. Reilly Washington Oct. 1968 20 p refs
(NASA-TM-X-1680) CFSTI: HC $3.00/MF $0.65 CSCL 18K

The ratio of gamma heating per gram of tungsten to gamma heating per gram of water was calculated for the case of a thin tungsten detector in a water shield. One dimensional transport theory calculations were used to obtain response polynomials which predict this ratio as a function of source energy, shield thickness, and detector thickness. Electron transport effects were also examined. Useful results are presented in the form of graphs. Author

N68-37339# Naval Research Lab., Washington, D. C.
NOTCH DUCTILITY AND TENSILE PROPERTY EVALUATION OF THE PM-2A REACTOR PRESSURE VESSEL
Charles Z. Serpan, Jr. 22 Apr. 1968 20 p refs
(Contract AT(49-5)-2110)
(NRL-6739) CFSTI: HC $3.00/MF $0.65

Following the pressurization-to-failure testing of the PM-2A reactor pressure vessel, several sections of steel were removed from the vessel wall in a region adjacent to the artificial defect. Charpy V-notch and tension test specimens machined from one of these sections have been evaluated. The irradiated-condition 30 ft-lb transition temperatures for the 1/4-thickness (nearest to the core) and 3/4-thickness locations in the vessel wall were +115°F and +55°F, respectively, for measured fission-spectrum fluences of 7.3 and 4.0×10^{18} n/cm^2 (>1 MeV). The 1/4-thickness properties and fluence most nearly represented those at the tip of the artificial defect. The 0.2% yield strength for the 1/4-thickness location was

97,620 psi at −20°F (failure temperature) and 92,200 psi at +72°F (temperature at time of acid-sharpening treatment of artificial defect). Significant uniform elongation, reduction of area, and elongation per 1 in. were retained by the steel. Author (NSA)

N68-37368# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EXPERIENCE IN DESIGNING AND OPERATING COMPUTER CONTROLLED REACTOR FACILITIES
Garth E. Driver 12 Jul. 1968 14 p
(Contract AT(45-1)-1830)
(BNWL-SA-1832) CFSTI: HC $3.00/MF $0.65

Uses of computers at reactor facilities are detailed. Experience with the computer associated with the HTLTR is discussed; the functions of the computer are described. NSA

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-36028 Maryland Univ., College Park.
GRAVITATIONAL RADIATION IN THE LIMIT OF HIGH FREQUENCY
Richard Allen Isaacson (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-511

A technique is described for obtaining approximate radiative solutions to the Einstein equations of general relativity in situations where the gravitational fields of interest are quite strong. The radiation is assumed to be of high frequency, and the field equations are expanded in powers of the small wavelength this supplies. This assumption provides an approximation scheme valid for all orders of $1/r$, for arbitrary velocities up to that of light, and for arbitrary intensities of the gravitational field. To lowest order, a gauge invariant linear wave equation for gravitational radiation is obtained, which is a covariant generalization of that for massless spin-two fields in flat space. This wave equation is then solved by the WKB approximation to show that gravitational waves travel on null geodesics with amplitude and frequency modified by gravitational fields in exactly the same way as are those of light waves, and with their polarization parallel transported along the geodesics, again as in the case for light. Dissert. Abstr.

N68-36057 Catholic Univ. of America, Washington, D. C.
THE APPLICATION OF INDUCED BRILLOUIN SCATTERING TO THE MEASUREMENTS OF HYPERSONIC VELOCITIES IN LIQUIDS AND MOLTEN GLASSES
Norman Richard Goldblatt (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17157

A theoretical and experimental investigation of induced or stimulated Brillouin scattering as it applies to the measurement of hypersonic velocities in liquids is reported. The wave equations for the incident and scattered light and sound wave are derived. Their solutions by Tang are reviewed. Incident intensity thresholds for induced Brillouin scattering are discussed and a new threshold for detection is developed which gives a more realistic method of calculating the minimum incident light intensity below which Brillouin scattered light cannot be detected. The relation between the Brillouin frequency shift and the elastic modulus of the scattering medium is examined critically. This relation is derived taking into account sound absorption. Dispersion can, in some cases, measurably alter the relationship between M and the Brillouin frequency shift. An experimental arrangement is described which enables hypersonic velocities to be measured to an accuracy of better than 0.5%. Dissert. Abstr.

N68-36078*# Heat Magnetic Engineering Co., Reno, Nev.
STUDY TO DEVELOP METHODS OF PREDICTING SPACECRAFT MAGNETIC FIELDS
Andrew A. Halacsy [1968] 179 p refs
(Contract NAS2-4316)
(NASA-CR-73256) CFSTI: $3.00 CSCL 20C

A procedure to calculate the magnetic field in three dimensions and in the neighborhood of a magnetic body of finite permeability is presented. Calculations are presented which define the m.m.f. grad in points of a three dimensional free space for an arbitrary current system; the total m.m.f. grad at points within magnetic bodies of field dependent permeability; and the 3 dimensional m.m.f. grad at any arbitrary point outside magnetic body or bodies. All calculations are computerized. The computer programs are explained in detail. Calculations are in good agreement with laboratory results. F.O.S.

N68-36099*# Scripta Technica, Inc., Washington, D. C.
THE RELATION BETWEEN THE WIEDEMANN EFFECT AND THE JOULE MAGNETOSTRICTION EFFECT [RELATION ENTRE L'EFFET WIEDEMANN ET L'EFFET JOULE DE MAGNETOSTRICTION]
M. E. Fromy NASA Oct. 1968 15 p refs Transl. into ENGLISH from J. Phys. (Paris), v. 14, no. 1, 1926 p 13-24
(Contract NASw-1694)
(NASA-TT-F-11725) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Wiedemann's magnetic torsion is a special case of Joule's magnetostriction. A cause and effect relation can be established between these two phenomena, provided all the deformations produced in the Joule effect by the inductor field are taken into account. In Wiedemann's experiments a tube is inserted into a helicoidal field which causes dimensional variations in all directions parallel to the field (the longitudinal Joule Effect) and perpendicular to it (the Transverse Joule effect). The study of these two effects shows an asymmetry which results in a twisting of the tube, and leads to an equation which accounts for all the peculiarities of the Wiedemann effect; in particular, it construes the existence of a maximum torsion and an inversion point for some fields different from those which produce some analogous effects in the Joule phenomenon. The torsion inversion is produced when the coefficients of the transverse and longitudinal Joule effects are equal and of the same sign. The composite curve of the Wiedemann effect, obtained from those of the two individual Joule effects, is in good accord with the experiment. Author

N68-36161# Israel Inst. of Tech., Haifa. Dept. of Mechanics.
THE PHYSICAL TENSOR AND APPLICATION Final Scientific Report, 1 Feb. 1967-31 Jan. 1968
Zvi Karni 30 Apr. 1968 77 p refs
(Grant AF-EOAR-20-67)
(TDM-68-10; AFOSR-68-1621; AD-673905)

The role of the source function in the balance equations for the electromechanical material continuum, is discussed. From a prototype source equation, being a differential invariant of a tensor potential, Poissons field equation and the Maxwell equations are deduced along a common and single procedure. By means of a representation theory for a second-order, asymmetric tensor, a general type of a constitutive equation for the asymmetric stress

is introduced into the plane electromechanical balance equations, and their solution discussed. The appearance of the curvature tensors into the balance equations for the electromechanical continuum with respect to a two-dimensional curved space, is explored towards a survey for their solution. Author (TAB)

N68-36170 Cornell Univ., Ithaca, N. Y.
IMPURITY STUDIES IN LIQUID HELIUM 4
Waymond Jay Pettit (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-672

Three impurity systems have been considered: (1) the infinitely dilute helium 3-helium 4 system from which the effective mass of the helium 3 impurity has been calculated; (2) the infinitely dilute helium 4 ion-helium 4 system from which the effective mass of the helium 4 ion impurity has been calculated; and (3) a more concentrated helium 3-helium 4 system from which the isotopic demixing of the system at finite concentrations has been found. A Jastrow type wave function has been assumed for this calculation. The effects of Fermi statistics have been included by antisymmetrizing the wave function by multiplying the Jastrow wave function by a Slater determinant. The Feynman theory has been used to calculate the effective masses of both the helium 3 and the helium 4 ion impurities. The effective mass of the helium 4 ion has been estimated both by nearest neighbor arguments and by binding energy arguments where a classical hydrodynamics effect has been included. Dissert. Abstr.

N68-36192# Ballistic Research Labs., Aberdeen Proving Ground, Md.
EXPLODING WIRE PARTICLE SIZE BY LIGHT SCATTERING MEASUREMENT
Faustin N. Weber and Donald D. Shear Jun. 1968 26 p refs
(BRL-R-1403; AD-673710)

The reddish color seen in photographs of exploding copper wires was assumed to be due in part to the scattering of the blue and green wavelengths of the BH6 mercury lamp used. Accordingly, this scattered light was used to measure particle size by the dissymmetry method. The average value of the predominant particle dimension was found to be time dependent with a value of 1200 A occurring .6 usec before the voltage peak. Author (TAB)

N68-36198# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
THE SYNTHESIS OF A RANDOM VARIABLE FROM A KNOWLEDGE OF ITS POWER SPECTRUM
Reginald T. Grant Aug. 1968 41 p
(FSR-AD6-04-68-1)

A practical solution is presented to the problem of the synthesis of a random variable from a knowledge of its power spectrum together with some deterministic and statistical application aspects. This capability has application to the onboard and inflight alignment of carrier aircraft inertial navigation system platforms. Application can also be made to mixing a variety of sensor and inertial data which feed into an aircraft navigation system. It is shown that any random variable with finite variance could be synthesized by a super position of low pass and band pass spectrums. It was further shown that one spectrum formulation, referred to as the basic spectrum, could be formulated as the spectrum of a random variable with an exponential-cosine autocorrelation function which would cover the entire range of low pass to band pass shapes. In addition, a practical formulation of the basic spectrum was developed by means of appropriate substitutions and bounding the variable parameters to inhibit singularities. Author

N68-36228 Stanford Univ., Calif.
SUPERFLUID HELIUM FLOW THROUGH AN ORIFICE
Walter Joseph Trela (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17516

Measurements were made using two different size orifices (radii, 5.6×10^{-2} cm and 1.7×10^{-2} cm) over the temperature range from 2.0°K to 0.46°K. This experiment was performed with an orifice placed in the wall separating two high Q (10⁷) superconducting microwave cavities. Flow through the orifice was excited via a heat pulse (thermomechanical effect) in one of the cavities. The subsequent motion of the helium through the orifice was observed by using the microwave cavities as level detectors. The energy used in forming vortex rings was found by measuring the damping of the liquid motion. Level differences of helium between the cavities as small as 5×10^{-6} cm were measured. The methods and apparatus used to measure these extremely small level differences are described. Dissert. Abstr.

N68-36260# Arizona Univ., Tucson. Optical Sciences.
A FOURIER THEORY OF STATISTICAL IMAGE FORMATION
B. Roy Frieden 21 Feb. 1968 44 p refs
(TR-22; PB-178686) CFSTI: HC $3.00/MF $0.65

The statistical approach must be used to describe the image when object brightness, optical pupil characteristics, and image detection are all subject to random fluctuations. Use of the statistical characteristic W (the Fourier transform of probability density) is found to clarify the phenomenon and to result in a linear theory. In the deterministic limit, the statistical theory goes over into the ordinary Fourier theory of image formation. Random detection noise is a natural parameter of the theory, so that application to practical problems seems eminently possible. Author (USGRDR)

N68-36294 Stanford Univ., Calif.
PROBABILITY DENSITIES FOR DIFFUSION PROCESSES WITH APPLICATIONS TO NONLINEAR FILTERING THEORY AND DETECTION THEORY
Tyrone Edward Duncan (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17412

Transition densities for Markov process solutions of a large class of stochastic differential equations are shown to exist and to satisfy Kolmogorov's equations. These results extend previously known results by allowing the drift coefficient to be unbounded. With these results for transition densities the nonlinear filtering problem is discussed and the conditional probability of the state vector of the system, conditioned on all the past observations, is shown to exist and a stochastic equation is derived for the evaluation in time of the conditional probability density. A stochastic differential equation is also obtained for the conditional moments. Dissert. Abstr.

N68-36329 Tulane Univ., New Orleans, La.
TRANSVERSE DISPERSION IN POROUS MEDIA
Robert Conery Hassinger (Ph.D. Thesis) 1967 162 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-17920

This study was undertaken to determine values of the transverse dispersion coefficient experimentally for a system of two miscible fluids of equal density and viscosity. A numerical solution to the differential equation describing transverse dispersion in the absence of longitudinal dispersion was obtained to enable one to calculate the dispersion coefficient from experimental results. The more general dispersion equation including longitudinal dispersion was also solved numerically to give quantitative limits of a dimensionless group within which the assumption of negligible longitudinal dispersion is justified. Possible experimental procedures

were examined and the simplest and most accurate one was chosen for the determination of transverse dispersion coefficients. Accurate values of these coefficients were determined for two sizes of packing material over a wide range of flow rates in the laminar regime. The theory that the dispersion coefficient should be proportional to the product of the packing size and the interstitial velocity was experimentally disproved. Dissert. Abstr.

N68-36346# Brookhaven National Lab., Upton, N. Y.
STEADY-STATE BEAM LOADING OF A STANDING WAVE LINAC RF SYSTEM
M. J. Lee [1968] 9 p refs Presented at the Conf. on Proton Linear Accelerators, Upton, N. Y.
(BNL-12589; CONF-680515-23) CFSTI: HC $3.00/MF $0.65

Two criteria which take into account the effects of steady state beam loading are considered theoretically for the design of a linac rf system. In one, the power transferred to the linac cavity is maximized for maximum beam current. In the other, the system is designed so that phase compensation for beam loading is not required. In general, it is not possible to have a system which meets both criteria. It is also shown that for any system, zero phase compensation is always obtainable provided that the load susceptance is adjustable. However, zero phase compensation is not always attainable for a system in which the generator susceptance, line length or cavity coupling coefficient is the only adjustable parameter. Author (NSA)

N68-36352# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN. A MONTHLY REVIEW OF SELECTED FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE, VOLUME 4, NUMBER 9
Sep. 1968 111 p refs

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1. OPEN MILLIMETER-BAND RESONATORS S. G. Hibben p 1–30 refs (See N68-36353 23-09)

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3. BINARY AND TERNARY GALLIUM AND INDIUM CHALOGENIDE SYSTEMS. PART 3: TERNARY SYSTEMS WITH A 1-, 2-, 3-, OR 5-GROUP ELEMENT J. Kourilo p 39–52 refs (See N68-36355 23-26)

N68-36361 Michigan Univ., Ann Arbor.
ELECTROMAGNETIC SCATTERING FROM RADIALLY INHOMOGENEOUS MEDIA
Piergiorgio Luigi Enrico Uslenghi (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-17852

This is a study of the scattering of electromagnetic waves by structures which are cylindrically or spherically symmetric, but inhomogeneous in the radial direction. It has applications to dielectric lenses at optical and microwave frequencies; to the propagation of radio waves in the ionosphere, and to their reflection by meteor trails; to the radar scattering behavior of, and to the radiation from, cylinders and spheres coated by layers of materials for ablating and camouflage purposes, or by a layer of plasma. The first two chapters are devoted to the consideration of the scattering of a plane electromagnetic wave from a cylinder and a sphere on whose surfaces an impedance boundary condition holds, and which are coated by one or two layers of materials whose indexes of refraction are not large compared to unity. Explicit solutions of the boundary value problem for various cylindrical structures are given in Chapter Three, and similar studies are performed for spherical structures in Chapter Four. An application is made to the spherical inverse-square-power dielectric lens, whose high frequency backscattered field is evaluated in Chapter Five, in terms of geometric optics, creeping wave and evanescent wave contributions. Dissert. Abstr.

N68-36382*# Wyle Labs., Huntsville, Ala. Testing Div.
AN EXPERIMENTAL PROGRAM FOR THE INVESTIGATION OF SHOCK-TURBULENCE INTERACTION PHENOMENA
S. W. Radcliffe Jun. 1968 36 p refs
(Contract NAS8-21100)
(NASA-CR-61985; TM-68-5) CFSTI: HC $3.00/MF $0.65 CSCL 20A

A series of experiments designed to examine the production of acoustic waves in the interaction of a shock wave and a turbulence environment is outlined. The approach is divided into five stages: apparatus design; development of instrumentation, in particular, hot wire and fluctuating and static pressure probe systems; a preliminary experiment to observe the interaction and try out the instrumentation; selection of a suitable turbulence generator; and finally conduct of the main experiment. Possible experimental difficulties are discussed. An experiment to observe fluctuating pressures due to expansion-turbulence interaction is also included in the program. Author

N68-36432 Stanford Univ., Calif.
MEASUREMENTS OF ANGULAR MOMENTUM IN SUPERFLUID HELIUM
George Burns Hess (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17437

Results are reported on an experiment to determine the equilibrium angular momentum of superfluid liquid helium 2 contained in a rotating cylindrical vessel. In the theories of Landau and London, the phenomenon of superfluidity results from a quantum mechanical constraint against rotational motion of the superfluid. If this is so, then, at any sufficiently low angular velocity $\omega < \omega_1$, the superfluid should have no angular momentum, not only in the state reached by accelerating the container from rest, but in thermodynamic equilibrium. The quantized vortex model of Onsager and Feynman allows a definite prediction of ω_1, which depends on the container radius, and of the equilibrium angular momentum at higher angular velocities. These calculations are carried out here for comparison with the experimental results. Dissert. Abstr.

N68-36460*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
MATHEMATICAL DETERMINATION OF GEOMETRICAL IMAGE ABERRATIONS IN SINGLE AND DOUBLE MIRROR SYSTEMS
Martin G. Hurwitz and Hubert F. A. Tschunko Washington Oct. 1968 25 p refs
(NASA-TN-D-4692) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The mathematical analyses to determine the image aberrations of single and double mirror systems are presented. The single mirrors, spherical and paraboloidal, are considered. Then, double mirror systems with paraboloidal primary and hyperboloidal secondary are considered, along with higher aspherics of the secondary and tolerances in the relative positions of the mirrors. This investigation is a first step in the evaluation of the imaging performance of single and double mirror systems. The general analysis available in the literature is not applicable without development for the special requirements of the present cast. This special raytracing is the prerequisite needed later for the Fourier transformations which serve to derive the image performance data necessary to the determination of wave optical aberrations. Author

N68-36470*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF EDGE CONSTRAINTS ON OPTICAL QUALITIES OF A SPACECRAFT WINDOW
David N. Warner, Jr. and Thomas M. Walsh Washington Oct. 1968 37 p refs
(NASA-TN-D-4845) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Some effects of edge constraints on optical qualities of Gemini spacecraft windows were determined experimentally. Frames approaching theoretical fixed-edge and free-edge constraints were designed and constructed for the investigation. Gemini window frames were also used so that the idealized frames could be compared to an operational window frame. Direct measurements were made of the flatness and wedge angle of the windowpanes, the resolution loss through the window, the angular deviation of a line of sight, and the distortion of a flat wave front traveling through the window assembly. Space pressure differentials were applied to the window to bow the panes and simulate the effect of the space environment. Tests showed that edge constraints on spacecraft windows significantly affect their optical qualities. The qualities become irregular, particularly at high incidence angles, as the panes are distorted in the simulated space environment. Although the clamped edge frames did not provide a strictly theoretical fixed-edge condition, they did allow less surface deflection, less angular deviation to the line of sight, and less distortion to a plane wave front. Author

N68-36485# Joint Inst. for Nuclear Research, Dubna (USSR).
GENERAL DESCRIPTION OF A GEOMETRICAL RECONSTRUCTION PROGRAM FOR LARGE CHAMBERS (1-6 VERSION)
N. N. Govorun, G. A. Emel'yanenko, N. F. Markova, V. I. Moroz, V. I. Nikitina et al Nov. 1967 21 p refs Transl. into ENGLISH from the Rept. JINR-P11-3480
(CERN-TRANS-67-8)

The geometrical reconstruction program, called 1-6, which takes into account the inhomogeneity of the magnetic field in the chamber, ionization losses, mutliple scattering, and bremsstrahlung is briefly described. The program is designed for processing events with not more than 15 tracks, photographed by a stereo-camera with not more than 6 objectives. It is written in IS-2 machine language for the M-20, BESM-ZM, and BESM-4. NSA

N68-36528# Chicago Aerial Industries, Inc., Barrington, Ill.
FIBER OPTICS WITH HIGH ULTRA-VIOLET TRANSMISSION Final Report
Charles W. Deneka 30 Jun. 1968 46 p refs
(Contract DA-28-043-AMC-02057(E))
(AD-673446)

The purpose of the report is to show the development of a glass composition which is suitable for use as a core material in fiber optic devices operated in the near UV portion of the spectrum. The report specifies the required properties of the glass. It also describes the approach used to obtain the optimum combination of these properties, consistent with available time, money and equipment. A short section on the basic theories is presented as background. Author (TAB)

N68-36708 Virginia Univ., Charlottesville.
THE SCINTILLATION OF LIQUID HELIUM UNDER PRESSURE
Forrest Jack Agee, Jr. (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17584

The scintillation of liquid helium induced by 5.28 MeV alpha particles has been investigated at temperatures between 1.26°K and 4.20°K at pressures ranging from the vapor pressure to 7.8 atm. The temperature dependence of the pulse height at constant pressure resembles that observed previously at the vapor pressure in the He II region, with the exception that the break in the curve at low temperature occurs at a lower temperature at high pressure. The sharp decrease at the lambda line is not seen except at the vapor pressure. The results are discussed in the light of (a) the contribution of recombination luminescence to the intensity, (b) the bubble model of electrons in liquid helium, and (c) the temperature and pressure dependence of the ionic diffusion coefficients. A description of the apparatus appears which includes the cryostat, pressure chamber, thermometry, pressure control and measurement, helium scintillation detection techniques, and a liquid level indicator. Dissert. Abstr.

N68-36742 California Inst. of Tech., Pasadena.
THEORY OF HOLOGRAPHY
John Wallace Matthews (Ph.D. Thesis) 1967 272 p
Available from Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 67-17069

A general analytical method is formulated for computing the diffracted fields in terms of the initial exposing field, the film characteristics, and the illumination field, taking into account the entire emulsion volume. This method, which is applicable to both transmission and reflection holograms, involves characterizing the emulsion volume by the volume density of scattering particles, with the diffracted field being found by coherently summing the scattered waves, neglecting multiple scattering. The initial exposing field and the illumination field are expressed in the form of a sum of plane or quasi-plane waves, and the diffracted field is expressed as a sum of waves, each of which is found by solving a variation of the same basic problem. The duplication of holograms is considered and the duplication process is described in terms of making a hologram of a hologram, rather than in terms of making a contact print. Dissert. Abstr.

N68-36744 Catholic Univ. of America, Washington, D. C.
INVESTIGATION OF THE LIQUID STATE BY RAYLEIGH SCATTERING
Douglas Arthur Pinnow (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17155

A liquid sample is illuminated with an intense monochromatic light beam of which a small but detectable portion is scattered by thermally driven fluctuations in the refractive index of the sample. The general theory for Rayleigh scattering due to the random orientations of molecules in liquids contains undetermined functions and is therefore of limited value in interpreting experimental results. An approximate theory, consistent with results, was developed. This theory is based on the assumption that the orientation of each molecule is independent of its position and its neighbors' orientations. Under this assumption the total intensity scattered from orientational fluctuations is directly proportional to the liquid density and orientational specific heat. Unlike an earlier theory, the intensity of light scattered from orientational fluctuations is not proportional to temperature. Experimental results in thirteen different liquids confirmed that scattered intensity varies directly as the density but is otherwise independent of temperature. Dissert. Abstr.

N68-36771# Arkansas Polytechnic Coll., Russellville.
THE BRAMLEY EFFECT Final Technical Report
Jack G. Dodd 30 May 1968 25 p refs
(Grant NSF GP-5612)

Enhanced scattering in a water Kerr cell under radio frequency excitation was found to be marked, thus confirming reports made

by Arthur Bramley in 1928. Large anomalous fluctuations in the Kerr constant of water, as reported by Bramley, were not observed. Wavelength shifts in scattered light were studied; and it was concluded that if Bramley red shift does exist, it must be connected with a Raman-type scattering event. M.W.R.

N68-36774*# Arizona Univ., Tucson. Space Astronomy of the Steward Observatory.
CONTROL OF STATIC ELECTRICITY IN 35MM FILM TRANSPORTS UNDER VACUUM CONDITIONS
W. G. Tifft and E. Nobles 1 May 1968 13 p
(Grant NSG-732)
(NASA-CR-97186; T-68-11) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Proper film transport is considered to be a major factor in eliminating the static electrical discharge in film transports in a vacuum. To accomplish effective controls, it is suggested that film slippage be avoided by transporting the film with minimal insulated contact at the sprockets, by isolating film with conductor to minimize point discharge sources, and by minimizing film bend angles and providing vacuum bearing design that keeps film stress to a minimum. A large vacuum chamber to form special photographic test images was used in the investigation. To eliminate moisture condensation at low temperatures, this chamber was evacuated to about 50 micron pressure, at which severe electrical discharge problems were noted. Discharge patterns of film to cassette, film to ground, film to film, and film to platen were considered for 35mm film strips. M.W.R.

N68-36812# Idaho Nuclear Corp., Idaho Falls.
ADJUSTER: A FORCE CONSTANT ADJUSTER PROGRAM TO OBTAIN LEAST SQUARES FIT TO OBSERVED FREQUENCIES OF MOLECULES AND CRYSTALS
J. K. Boyter and H. L. Mc Murry Dec. 1967 11 p
(Contract AT(10-1)-1230)
(IN-1148) CFSTI: HC $3.00/MF $0.65

A FORTRAN program for the IBM 7040 is described which is a force-constant adjuster to obtain a least squares fit to observed frequencies of molecules and crystals. The J input cards may be punched by the program MACS. Author (NSA)

N68-36899# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND A CLASS OF VARIATIONAL PROBLEMS
J. Casti, R. Kalaba, and B. Vereeke Aug. 1968 19 p refs
(Contract F44620-67-C-0045)
(RM-5702-PR; AD-673344)

Many problems in physics, technology, biology, and operations research lead to the minimization of a functional, and typically the minimizer is characterized as the solution of an Euler equation, together with certain boundary conditions. One aim of the theory of invariant imbedding is to convert these boundary value problems into initial-value problems which have certain computational advantages. This study shows that for a class of minimization problems, the invariant imbedding equations can be obtained directly form the variational problem without making use of the Euler equation or Bellman's principle of optimality. It then shows that the solution of the initial-value problem satisfies the Euler equation. Author (TAB)

N68-36924# California Univ., Berkeley. Lawrence Radiation Lab.
CHOICE OF COORDINATE SYSTEM IN ELLIPSOMETRY
Rolf H. Muller Sep. 1967 12 p refs
(Contract W-7405-ENG-48)
(UCRL-17841) CFSTI: HC $3.00/MF $0.65

A discussion to clarify and unify the coordinate system used in the analysis of elliptic polarization of reflected light is presented. NSA

N68-36936# European Space Technology Center, Noordwijk (Netherlands).
COMPUTER ANALYSIS OF INFRA-RED SPECTRA
A. Accensi and J. Dauphin Paris ESRO May 1968 50 p refs
(ESRO-TN-27(ESTEC)) CFSTI: HC $3.00/MF $0.65

Infra-red analysis involves the qualitative estimation of the compounds present in a mixture and the quantitative evaluation of their relative concentrations. Infrared spectrometry is particularly suitable for space applications, mainly for the analysis of condensable outgassing products from materials and components under vacuum conditions and in solving some contamination problems arising during the pre-launch testing. The infrared spectra are, in general, very complex and show, at least for organic materials, a large number of absorption bands frequently overlapping each other. The manual analysis of such spectra is a lengthy and tedious process, often leading to rather inaccurate results. The automatisation of the infrared spectral analysis is not an easy task and, since extensive computations are involved, it requires access to a modern digital computer. A system of computer programs for determining both the identity and the concentration of the constituents of an unknown spectrum is being developed at ESTEC. The proposed system, which it is felt will represent a significant contribution towards the progress of spectral analysis techniques, is described. Author (ESRO)

N68-36967 Technische Hochschule Hannover (West Germany).
THE FIRST COULOMB LAW AS THE UNDERLYING PRINCIPLE OF ELECTRODYNAMICS [DAS ERSTE COULOMBSCHE GESETZ ALS GRUNDLAGE DER ELEKTRODYNAMIK]
Hansjuergen Bausch (Ph.D. Thesis) 1968 150 p refs In GERMAN
CFSTI: $3.00

The elementary law of electrodynamics is derived from the first law of Coulomb by generalization in two steps. First, constant velocities of charges are assumed, thus making it possible to use the special relativity theory for the generalization. Next, the simplest special case of accelerated motion, i.e. hyperbolic motion, is examined, in which the charge is accelerated at a constant velocity in any given inertial system. The general relativity theory is applicable in this case. Transl. by K.W.

N68-36978# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
ANNUAL REPORT, 1967 [JAHRESBERICHT, 1967]
Jul. 1968 263 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Research activities at the Aerospace Institute during 1967 are reported in this survey. Main emphasis was placed on: (1) perturbation mechanics; (2) mechanical stability, building materials and building methods; (3) propulsion and energy; (4) aircraft control and electronic equipment; (5) space flight physics; and (6) aerospace medicine. Transl. by G.G.

N68-37070# International Centre for Theoretical Physics, Trieste (Italy).
THE PHYSICS OF LOGIC
D. Finkelstein May 1968 31 p refs Sponsored by NSF
Submitted for publication
(IC-68-35) CFSTI: HC $3.00/MF $0.65

The quantum theory implies a modification of the empirical logic of the real world, a revolution at a deeper level than that of general relativity but analogous in many ways. An operational or empirical logic is outlined to sharpen this statement. The path from this operational logic to conventional quantum theory in a complex Hilbert space is laid out. The process called 'second quantization', and which is not quantization at all, does in quantum logic what quantification does in classical logic and should be so called. Third, fourth, ... K_0 quantification are meaningful and are defined. Evasions of von Neumann's 'hidden variables' theorem are constructed, analogous to the imbedding of curved space in a higher dimensional flat space but the relevance of these to physics is doubted. Author (ESRO)

N68-37236 Michigan Univ., Ann Arbor.
A GENERAL ANALYSIS OF CONTOUR HOLOGRAPHY
Bernard Percy Hildebrand (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17777

The application of holography to measurement is explored. A general analysis of the holographic process is developed based on the theory of partial coherence. The final expression describing the imaging properties of the hologram includes a term which leads to the prediction that is is possible to make a hologram whose image has constant range contours superimposed on it. The theory predicts that two distinct methods may be used to achieve contouring. The first of these requires a light source containing a number of equally spaced discrete frequencies. The contours so produced represent the intersection of a family of spherical surfaces (centered at the hologram center) with the object. The second method for obtaining contoured images is to provide an illuminating wavefront made up of a number of collimated beams with small angular separation. The contours then represent the intersection of a family of planes with the object. Dissert. Abstr.

N68-37250# DuPont de Nemours (E.I.) and Co., Wilmington, Del.
HOLOGRAPHIC BINARY INFORMATION STORAGE
J. D. Lee 24 Sep. 1968 21 p refs Presented at the Opt. Soc. of Am. Meeting, Pittsburgh, 8 Oct. 1968 Sponsored by Holotron Corp., Wilmington, Del.

High density binary information storage and retrieval is discussed. Using an optical system limited by the space-bandwidth product, a storage density of 1.5×10^7 bits/cm^2 has been achieved. Wavefront storage is performed near the Fourier transform plane of a binary transmission information mask, and information is retrieved with reduced positional tolerances of the hologram relative to that of conventional photographic systems. Attention is given to diffraction efficiency of the hologram and to the signal-to-noise ratio in the reconstructed image. Author

N68-37269# Rensselaer Polytechnic Inst., Troy, N. Y.
ELECTROMAGNETIC SCATTERING BY SPHERES OF ANISOTROPIC REFRACTIVE INDICES
Ru Tsang Wang (Ph.D. Thesis) 1 Feb. 1968 225 p refs

An empirical procedure of investigating the electromagnetic scattering by spheres of anisotropic refractive indices is described. The experiment uses a linearly polarized microwave radiation, and emphasis is placed on the measurement of the complex amplitude of the forward scattered wave by recording its two time quadrature components, from which the extinction cross section of the scatterer can also be reduced using the Optical Theorem. Spheres of several degrees of anisotropy are studied. They were constructed out of fine layered composite media alternately conducting (or absorbing) and dielectric. The microwave properties of these materials for three principal orientations of the layered medium with respect to the incident wave polarization are measured by the waveguide slotted line technique. The refractive index data thus obtained are then used to analyze the scattering data. Author

N68-37279# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
ATTENUATION OF THE RAYLEIGH COMPONENT IN BRILLOUIN SPECTROSCOPY USING INTERFEROMETRIC FILTERING
K. H. Langley and N. C. Ford, Jr. [1968] 13 p refs
(Grants NSF GP-5158; NSF GP-7912)

A filter based on an unequal arm Michelson interferometer is described that will attenuate a strong spectral line by a factor of 100 or more but transmit without reduction a weaker but more interesting line separated by a few hundred MHz from the strong line. The factors limiting the extinction ratio of the filter are considered and a practical instrument that gives results in good agreement with the theory is described. Author

N68-37283*# Avco-Everett Research Lab., Everett, Mass.
ADVANCED SUPERCONDUCTING MAGNETS INVESTIGATION
Z. J. J. Stekly, R. Thorne, E. Lucas, B. P. Strauss, and F. DiSalvo Apr. 1968 169 p refs
(Contract NAS8-21037)
(NASA-CR-98030) CFSTI: HC $3.00/MF $0.65 CSCL 20C

The behavior of a composite superconductor, consisting of the superconductor itself and a highly conducting substrate in which all gradients along the conductor are neglected, is analyzed. The simplest case considered is that of a conductor exposed to a coolant which is assumed to have a constant heat transfer coefficient. The effect of the transition from nucleate to film boiling is investigated and a general steady state stability map is developed. Following the zero dimensional analyses, a one dimensional model in which gradients along the conductor are taken into account was analyzed. Both analyses assume heat transfer to a coolant which can convect heat away. In either of these cases it is not possible to conduct heat to a heat sink very far away without large temperature gradients. The case of three dimensional heat transfer was investigated, and the special case of only conduction cooling was solved. The predictions of the analytical models were verified experimentally. Specific tests were run on single wires heated locally to verify the results obtained in one dimensional analysis. Another series of test involved the behavior of a 6" diameter coil wound with square copper stabilized Nb–Ti conductor. Author

N68-37323# Catholic Univ. of America, Washington, D. C. Dept. of Chemistry.
COMPUTER CURVE FITTING OF MOESSBAUER SPECTRA USING ALGOL WITH COMPUTER TIME-SHARING SYSTEM
Leopold May, S. J. Druck, and Martha Sellers 1 Jul. 1968 20 p
(Contract AT(30-1)-3798)
(NYO-3798-2) CFSTI: HC $3.00/MF $0.65

A computer program (MOSSL) is presented which fits a series of Moessbauer peaks (Lorentzians), superimposed upon a base-line parabola by the method of minimizing the value of the sum-squared residuals of deviations. The data involve the number of counts collected on each of 200 channels of the multichannel analyzer of a Moessbauer spectrometer. The program is written in DARTMOUTH–ALGOL for use on the time-sharing system CEIR. NSA

N68-37327# Paris Univ. (France). Inst. of Nuclear Physics.
CURVE FITTING IN OPTICAL MODEL
J. Hoegaasen Jan. 1968 10 p refs
(IPNO/TH-117)

The failure of the chi-squared criterion in fitting data with a strongly oscillatory pattern is analyzed, and a more satisfactory criterion is proposed and demonstrated. NSA

N68-37342# Arkansas Univ., Fayetteville. Plasma Lab.
ENERGY TRANSFER PROBLEMS IN SUPERCONDUCTORS AND FLOWING PLASMAS Final Report
Denys O. Akhurst, Martin J. McCutcheon, and Melvin K. Anderson
Oct. 1967 259 p refs
(Contract DA-01-021-AMC-12820(Z))
(UAPL-31; AD-673292)

The final report on energy transfer problems in superconductors and flowing plasmas describes theoretical and experimental studies of energy storage and transfer in cryogenics and magnetohydrodynamics. In the cryogenic studies, electrical energy is stored in superconducting coils and extracted with a 98% energy transfer efficiency. Theoretical support is given for the switching, storage and extraction results. In the magnetohydrodynamic studies, electrical energy is extracted from the high temperature plasma flow through a dc MHD generator. Included in the study is a survey of dc and ac MHD generators, an analysis of cylindrical ac MHD generators, and investigation of a pulsed induction ac MHD generator and the design and operation of a small scale dc MHD generator. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-36012 European Organization for Nuclear Research, Geneva (Switzerland). Proton Synchrotron Machine Div.
PHASE ACCEPTANCE OF QUADRUPOLE DOUBLETS: ANALYTICAL APPROACH
E. Regenstreif 22 Jul. 1968 52 p refs
(CERN-68-28)

Analytical expressions were derived for the phase acceptance of a quadrupole doublet in both the cd and dc phases, with consideration given to the lens strengths and the length of inter-lens drift space. Because the phase acceptance area of a general doublet has no mathematical maximum, optimization is not possible. Instead, drift length must be as small as possible and lens as short and as strong as possible. Shapes of the acceptance contours at the entrance of the doublet are treated for both planes and for rotation of the acceptance contour. An application is presented in which the two quadrupoles composing the doublet are identical elements; and universal curves were drawn for this case. Two theorems are stated that permit the the extension of the overall theory to quadrupole triplets and more complicated multiplets. M.W.R.

N68-36015 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
PROTON SPIN ORIENTATION
M. Borghini 5 Aug. 1968 55 p refs
(CERN-68-32)

Methods used for polarizing protons are discussed in terms of the overall area of nuclear orientation, thermodynamical methods and optical pumping are noted as the methods for producing nuclear spin differences; and nuclear spin interactions are treated in magnetic fields and in electric field gradients. Further details on the static orientation of nuclei deal with the paramegnetic substance, the spin Hamiltonian in paramagnets, polarization by brute force, and ferromagnets and antiferromagnets. Uses of oriented nuclei and low temperature techniques are discussed. Static spin properties of protons and spin-lattice relaxation are treated for deuterium hydride, hydrogen, methane, and other substances. Dynamic polarization of protons by electron-nucleus dipolar coupling is considered in terms of spin Hamiltonian and energy levels, radio frequency-induced transitions, spin-lattice relaxation, solid state effect, and spin diffusion. Negative temperatures and "donkey" effects are mentioned, as is the spin refrigerator mechanism. M.W.R.

N68-36036 California Univ., Berkeley.
RESONANCES AND KINEMATICAL PEAKS IN STRONG INTERACTIONS
Ivan Kramer (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-97

Two peripheral models involving pion-nucleon reactions leading to a four-body final state are studied with particular respect to the predictions of the models for various three-particle invariant mass distributions. These predictions are compared in detail to experimental results. The peaks in the mass distributions produced by the models, being accidents of the phase space, cannot be associated with true resonances. The first model considered assumes a double two-particle resonance intermediate state. The second model contains one two-particle resonance and one virtual nucleon and is used in fitting diffraction scattering data. The entire formalism contained herein assumes arbitrary values for the center of mass energy and all masses involved. Thus, the results can easily be applied to a variety of different reactions at a variety of different energies. Dissert. Abstr.

N68-36037 Maryland Univ., College Park.
THE FIRST FORBIDDEN BETA DECAYS IN THE RARE EARTH REGION
Yurdanur Akovali Ellis (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-504

In this dissertation, the properties of nuclear states in the mass 144 region are studied in a systematic way by consideration of first forbidden beta transitions. Specifically, the spectrum shapes of the ground state to ground state and the ground state to excited states forbidden beta transitions, and the beta-gamma correlations between the ground state to excited state beta transitions and the excited state to ground state gamma transitions are investigated and calculated in detail on the basis of the shell model and of the collective model. In the formulation of the theory of forbidden beta transitions, the beta interaction in the form of V – 1.2 A and the j–j coupling model and collective model are adopted. Particular attention is given to the states of, and the beta transitions between $_{58}Ce^{144}$, $_{59}Pr^{144}$, $_{60}Nd^{144}$ nuclei. The comparisons of the theoretical calculations with the experimental results enable us to deduce information with regard to nuclear states which have been the subject of great confusion. The angular distribution of the beta particles from the ground state of oriented Pr^{144} nucleus to the Nd^{144} ground state is also computed for the purpose of comparison with contemplated experiments. Dissert. Abstr.

N68-36067 Michigan Univ., Ann Arbor.
ASPECTS OF THE THEORY OF ELECTRONS IN LIQUID HELIUM
Shou-yih Wang (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17855

The bubble model for the electron is described, in which the electron sees a spherical square well potential of finite depth in the liquid helium. The Wigner–Seitz model is employed in

determining the barrier height for the electron. A systematic, self-consistent calculation of bubble parameters is presented. Since the surface tension is required to determine the size of the bubble and since the surface tension is not known, this question is left open. The photoejection cross section as a function of photon energy was calculated for the process of photoejection of electrons from the bubble states. The relevant cross section including resonant phenomena is calculated. The expression for the phonon-limited mobility of the negative ion was derived both from Arkhipov's approach and from the Boltzmann equation with the same result. Comparison of the theoretical results with experimental data indicates a bubble radius over 20 Å at zero external pressure. Dissert. Abstr.

N68-36070*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION AND ANALYSIS OF DIELECTRIC BREAKDOWNS INDUCED BY ELECTRON IRRADIATION IN POLYMER FILMS

George M. Storti Washington Oct. 1968 35 p refs

(NASA-TN-D-4810) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The phenomenon of dielectric breakdowns caused by electron irradiation was investigated in several polymeric materials. The frequency of occurrence of the breakdowns (as measured by the number of breakdowns occurring for a given fluence of electrons) was dependent on factors such as the electron kinetic energy, electron flux, sample radiation history, and sample temperature. Also, some materials (for example, Teflon) were found to be more susceptible to the dielectric breakdowns than others (for example, polyethylene). These results were interpreted in terms of a modified band model for organic insulators. This modified band model successfully explained many of the experimental observations. Consequently, relative depths of electron traps in some of the materials were surmised from the experimental data. Author

N68-36079 Maryland Univ., College Park.

DYNAMICAL MODEL OF NONLEPTONIC DECAYS AND SCALAR MESONS

David Scott Loebbaka (Ph.D. Thesis) 1967 179 p

Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-523

The basis for the model is the assumption that the matrix elements, written in terms of initial state minus final state momenta, are dominated by the low mass mesons in a sense of dispersion theory. In the parity violating amplitudes, this assumption corresponds to the nonleptonic decays being dominated by the K^*_1 → vacuum transition. It has been pointed out that such a model is forbidden in the limit of SU(3) symmetry. It is shown, however, that the physical amplitudes do not necessarily reflect this forbiddeness. The parity violating nonleptonic hyperon decay amplitudes are fit in this model, and it is shown that it is possible to fit the ratios of the weak decay amplitudes with coupling constants determined solely by the strong interactions. Dissert. Abstr.

N68-36094# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

REPORT OF AD HOC PANEL ON ASTRON PROGRAM Final Report

Keith A. Brueckner (Calif. Univ., San Diego), Peter L. Auer (Cornell Univ.), Nicholas C. Christofilos (Lawrence Radiation Lab.), R. A. Dandl (Oak Ridge Natl. Lab.), John M. Dawson (Princeton Univ.), et al Feb. 1968 33 p

(TID-24513) CFSTI: HC $3.00/MF $0.65

The fourth report of the ad hoc panel is presented with the threefold purpose of (1) reviewing the theory on which the Astron concept is based, (2) delineating the problems and uncertainties still to be resolved in the Astron Program, and (3) reviewing and evaluating the scientific and technical feasibility of building the proposed accelerator. The Astron concept utilizes a relativistic electron layer to create a magnetic configuration capable of creating and confining a hot plasma. Present theoretical and experimental results are discussed in relation to the injection and trapping of electrons, and the instabilities and decay of the electron layer. Consideration is also given to plasma stability and loss, and beam-plasma interactions. B.S.D.

N68-36101 Stanford Univ., Calif.

RENORMALIZATION OF THE SCATTERING THEORY OF PIONS AND NUCLEONS

Rodney Wayne Johnson (Ph.D. Thesis) 1967 120 p

Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-17445

The Dyson–Salam approach to renormalization is applied to the $\lambda\phi^4$ meson scattering theory and to the pseudoscalar pion–nucleon theory. Starting from the unrenormalized perturbation series, a formal derivation and justification of the renormalized perturbation series is given by detailed analysis of sets of Feynman graphs. It is verified by Weinbers's theorem that the renormalized series are indeed given by convergent integrals to any finite order in perturbation theory. Dissert. Abstr.

N68-36116 California Univ., Los Angeles.

MULTI-PION SYSTEMS: SYMMETRIES AND THE HYDROGEN ATOM

Donald Joseph Levy (Ph.D. Thesis) 1967 146 p

Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-226

Several multi-pion systems are studied. It is found that the sigma I = 0 J = 0 can exist as a four pion bound state. This four pion system is further studied by including the effects of the two pion channels. A coupled channel N/D calculation is carried out which determines the mass shift of the sigma due to the two pion channels, and determines the sigma's decay width into two pions. The connection between group properties and dynamical properties of systems of particles is considered. In particular, we study the hydrogen atom, which has O_4 symmetry for bound states and is related to the homogeneous Lorentz group for positive energy states. Properties of both positive and negative energy solutions of the homogeneous Schrödinger equation for the hydrogen atom are discussed. Formulated is a general method for solving potential scattering problems. This method transforms the Lippman–Schwinger equations into integral equations on the group space of O_3. Dissert. Abstr.

N68-36116 Texas A&M Univ., College Station.

STUDY OF NUCLEAR RESONANCE EFFECTS BY THE DOUBLE SCATTERING OF NEUTRON CAPTURE GAMMA RAYS

Cyrus Jamasp Kapadia (Ph.D. Thesis) 1967 120 p

Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-16461

An experiment is described which utilizes the excellent energy resolution (1:10⁶) of neutron-capture gamma rays in order to determine nuclear energy-level widths at energies between 6 and 10 MeV. As an initial experiment, the level in ^{208}Pb responsible for the scattering was studied by scattering the emerging gamma rays a second time. It was found, as expected, that the resonance scattering was reduced as the first scattering angle was increased from near 0°. The linewidth can then be determined from these data. Another parameter that may be found is the separation energy between the incident line in the iron spectrum and the resonance level in lead. Denoting these quantities by Γ and δ, respectively, the following values have been observed in the present investigation: $\Gamma = 0.77 \pm 0.05$ eV; and $\delta = -9.55 \pm 0.40$ eV. These values are in agreement with the measurements made by other methods. Dissert. Abstr.

N68-36122 Utah Univ., Salt Lake City.
STIMULATED EMISSION IN POLYATOMIC MOLECULES
William Charles Carr (Ph.D. Thesis) 1967 214 p
Available from Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-17872

Comparison between the vapor pressure characteristics of pure elements and their associated molecular compounds is presented, with the observation that many molecular compounds of normally solid elements have significant vapor pressures at room temperatures. The general requirements for obtaining stimulated emission are discussed, along with specific mechanisms by which the necessary population inversion of energy states may be achieved. A discussion of molecular energy states is presented, and it is noted that the excited molecule may exist in either an attractive state or a repulsive state. If the molecule is excited to this repulsive state, dissociation of the molecule occurs, and the several dissociation products of this process are discussed. The energy requirements for the dissociation and excitation of the polyatomic molecules $SiCl_4$ and $SnCl_4$ are known, and these values are given. The observation of stimulated emission in $SiCl_4$, $SnCl_4$, $SnBr_4$, and SnI_4 is reported. Dissert. Abstr.

N68-36123 Brigham Young Univ., Provo, Utah.
NEUTRON DIFFRACTION STUDIES ON α-Fe_2O_3 AND Cr_2O_3 AT HIGH PRESSURE
Thomas Grover Worlton (Ph.D. Thesis) 1967 112 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-17227

Neutron diffraction studies have veen made of α-Fe_2O_3 and Cr_2O_3 at high pressure. It was found that the temperature of the spin flip or Morin transition in α-Fe_2O_3 increases at the rate of 3.7 ± 0.3° C/kbar to 6 kbar and then increases at the rate of 1.0 ± 0.3° C/kbar to 6 kbar and then increases at the rate of 1.0 ± 0.3°C/kbar from 6 to 31 kbar. Above 5 kbar there is a smearing of the transition and a decrease of the critical angle of the spin flip. The angle which the spins make with the [111] axis at room temperature was found to decrease from 90° at 5 kbar to 53° at 14 kbar and remain practically constant from 14 to 31 kbar. The spin angles determined from these neutron diffraction measurements are in excellent agreement with the spin angles calculated from Mossbauer effect measurements of the quadrupole splitting. Neutron diffraction measurements of the Néel temperature of Cr_2O_3 were made to 13.3 kbar. It was found that the Néel temperature decreases linearly at the rate of -1.6 ± 0.3° C/kbar. The intensities of the magnetic diffraction peaks followed the typical Brillouin function temperature dependence in the temperature range investigated. Dissert. Abstr.

N68-36124 California Univ., Berkeley.
HYPERFINE STRUCTURE AND ISOTOPE SHIFT OF THE NEUTRON DEFICIENT THALLIUM ISOTOPES
David Goorvitch (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-68

The isotope shift of the thallium isotopes 198*m* (1.9h), 196*m* (1.4h), 195 (1.2h) and 194*m* (33m) has been measured in the spectrum lines at 3776 Å ($^2S_{1/2} \rightarrow {}^2P_{1/2}$) and 5350 Å ($^2S_{1/2} \rightarrow {}^2P_{3/2}$). The isotope shifts of the odd mass thallium isotopes are regularly spaced, indicating a pure volume effect with an isotope shift constant of 59 mK. The even mass thallium isotopes, on the other hand, exhibit an increase in staggering with a decrease in the neutron number, indicating configuration interaction between the odd proton and the unfilled neutron shell. The hyperfine structure of thallium 195 has also been measured in both lines. The measured magnetic dipole constants are $A(^2S_{1/2})$ = 394 5 mK, $A(^2P_{1/2})$ = 694 ± 5 mK and $A(^2P_{3/2})$ = 7.5 ± 7 mK. The derived magnetic dipole moment is μ_1 = 1.55 ± 0.04 nm. Dissert. Abstr.

N68-36138# Los Alamos Scientific Lab., N. Mex.
A STUDY OF THE (T,P) REACTION ON ZIRCONIUM 90, 92, 94, 96 AND TIN 122, 124
Jerome G. Beery 28 Jun. 1968 110 p refs
(Contract W-7405-eng-36)
(LA-3958) CFSTI: HC $3.00/MF $0.65

A study was made of the (t,p) reaction on targets of ^{90}Zr, ^{92}Zr, ^{94}Zr, ^{96}Zr, ^{122}Sn and ^{124}Sn. The purpose was to investigate the nuclear energy levels that are populated by putting two neutrons into a target nucleus. The targets were bombarded with 20-MeV tritons from the Los Alamos tandem Van de Graaff facility. Protons were detected with a solid state counter telescope, and the data were recorded with an on-line digital computer. Energy spectra were taken for each of the targets utilizing a magnetic spectrometer in order to obtain excitation energies with an accuracy of ± 10 KeV. The zirconium data are analyzed with a distorted wave Born approximation calculation, and relative spectroscopic strengths are obtained. The energy level positions and strengths are compared to a nuclear structure calculation. Author (NSA)

N68-36150 California Univ., Los Angeles.
ENERGY DEPENDENCE OF PROTON OXYGEN 16 ELASTIC SCATTERING BETWEEN 20 AND 50 MeV AND THE OPTICAL MODEL
John Montgomery Cameron (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-206

Differential cross sections for the elastic scattering of protons by oxygen were measured at incident proton energies of 23.4, 24.5, 27.3, 30.1, 34.1, 36.8, 39.7, 43.1, and 46.1 MeV. The data cover the center of mass scattering angles from 10 to 160 degrees and have a relative uncertainty smaller than 2%. An oxygen gas target was bombarded with protons obtained using the variable energy extraction system of the UCLA sector-focused cyclotron. The scattered protons were detected using an array of four NaI (Tl) scintillation counters. The results show strong resonances to exist below 30 MeV which appreciably distort the monotonic energy variation found at the higher energies. The results have been compared with those obtained by other investigators in this energy region. Dissert. Abstr.

N68-36171 European Organization for Nuclear Research, Geneva (Switzerland). Track Chambers Div.
PARTICLE SEPARATION WITH TWO AND THREE CAVITY RF SEPARATORS AT CERN
P. Bernard, P. Lazeyras, H. Lengeler, and V. Vaghin 22 Jul. 1968 69 p refs
(CERN-68-29)

The principle of operation of the two- and three-cavity Schnell-type separator is described, and the momenta regions of one- and two-particle rejection are computed. In the two-cavity separator, two-particle rejection is possible only in some very small momenta regions, whereas in the three-cavity separator it is possible over a large continuous momentum range. For the CERN three-cavity separator (total intercavity distance 50 m, frequency 2855 MHz) it is found that separation of kaons and pions is, in principle, possible between 7 and 16 GeV/c, and for antiprotons between 7 and 18 GeV/c. The RF separated beam (u_3 beam) for the CERN 2 m hydrogen bubble chamber is described briefly, and its main parameters are given. It can work as a separated and unseparated beam up to 20 GeV/c with a minumum momentum bite $\Delta p/p = \pm 0.25\%$ and a maximum solid angle at the target $\Delta\Omega$ = 150 μsr. As the pulse length of the RF separator does not exceed 8 μsec, it must be used in conjunction with a fast-ejected proton beam from the CERN Proton Synchrotron (CPS). An external target (2 × 1 mm² cross-section) allows use of secondaries produced under 0°. Author

N68-36208# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
SUMMARY OF PHOTOPRODUCTION AND LEPTONIC DECAYS OF VECTOR MESONS
Samuel C. C. Ting Hamburg, West Germany Deut. Elektronen-Synchrotron May 1968 18 p Presented at the Conf. on Exptl. Meson Spectroscopy, Philadelphia.
(DESY-68/29; CONF-680428-5) CFSTI: HC $3.00/MF $0.65

Tables and graphs are presented showing data on the photoproduction and leptonic decays of vector mesons. Included are interacting particles, production cross sections, primary energies, mass width, coupling constrants, decay modes, angular distribution, and yields. NSA

N68-36209# Institute of Nuclear Research, Krakow (Poland).
SHORT REVIEW OF SOME MOESSBAUER EFFECT EXPERIMENTS FOR IMPURITY ATOMS
J. Bara and A. Z. Hrynkiewicz Feb. 1968 19 p refs Presented at the Conf. on the Moessbauer Effect, Varna, Bulgaria
(INP-590/PL; CONF-670971-1)

The paper contains a short review of the experimental results of the Debye–Waller factor and isomer shift measurements for impurity atoms. The experimental data for the Debye–Waller factors might be described theoretically in the Debye approximation of the crystal lattice, under the assumption that force constants for the host-impurity atoms are almost the same as for host—host atoms. Interesting correlations between the isomer shifts for impurity atoms and various properties of solids are pointed out. Author (NSA)

N68-36210# California Univ., Berkeley. Lawrence Radiation Lab.
A SEARCH FOR A K* BELOW K PI THRESHOLD
R. W. Bland, G. Goldhaber, B. H. Hall, and G. H. Trilling 19 Apr. 1968 5 p Presented at the Conf. on Exptl. Meson Spectroscopy, Philadelphia
(Contract W-7405-ENG-48)
(UCRL-18206; CONF-680428-3) CFSTI: HC $3.00/MF $0.65

A search was made for the production of a scalar meson (K^*) having a mass below the $K\pi$ threshold and decaying predominantly via the $K_{\pi\pi}$ mode in meson (K+) interactions on hydrogen near 1 GeV/c. No evidence was found for its existence, and upper limits were placed on its production cross section. The reaction $K^+ + p \rightarrow K^*_S + p$, $K^*_S \rightarrow K^+ +$ neutrals in a hydrogen bubble chamber was investigated. Distributions of the mass recoiling against the final-state proton at 1200 MeV/c are shown. NSA

N68-36213 Wisconsin Univ., Madison.
A STUDY OF NEGATIVE PION PROTON YIELD OMEGA NEUTRON, PHI NEUTRON AT 2.10 BeV/c AND NEGATIVE PION PROTON ELASTIC SCATTERING AT 1.89 AND 2.10 BeV/c
James Hamilton Boyd (Ph.D. Thesis) 1967 171 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-10622

In a bubble chamber experiment at 2.10 BeV/c we have determined the cross section $\sigma(\pi^- p \rightarrow \omega n) = 1.41 \pm .18$ mb by fitting the neutral and the charged effective mass spectra for events of the type $\pi^- p \rightarrow \pi^+ \pi^- n(m)\ \pi^0$; $m \geq 1$ with appropriate phase space and resonance effective mass distributions. Cross sections for other contributing reactions are also given. The cross section was obtained by using the maximum likelihood method to determine the cross section corresponding to a peak (at the ϕ mass 1019.5 MeV) in the K+K− effective mass spectrum of K+K−n events. The relative probability of the cross section being zero is .07. We conclude that $\sigma(\pi^- p \rightarrow K^+ K^- n)$ is between 75 and 150 μb at 2.10 BeV/c. The K-pair events studied include both events with and without a K-decay. The non-decay event identification procedure included a visual bubble density estimation. We calculate an $\omega - \phi$ mixing angle of 42.1 ± 1.4° (statistical error) using a quark model prediction of Lipkin and Scheck. Dissert. Abstr.

N68-36221 Purdue Univ., Lafayette, Ind.
COLLECTIVE EXCITATIONS OF DIPOLAR SYSTEMS
Robert Leal Lobo E Silva (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-16674

A system of neutral molecules having permanent electric dipole moments should exhibit self-sustained longitudinal polarization waves analogous to the plasma vibrations of an electron gas. To study these long-wave length collective modes (dipolar plasmons), we adapt some technique successful in many-electron problems to systems whose Hamiltonians include kinetic energy of both center of mass and of rotational motion, the interaction between rigid dipoles, and short-range interactions which we need not specify in detail. A canonical transformation plus a random phase approximation is used to display the collective modes explicitly in the Hamiltonian, and it is shown that the ground state of the system is adequately described in the random phase approximation. The dipolar plasmon frequency so found is also obtained by linearizing equations of motion for Fourier components of the polarization charge density, and is affected statistically by short-range through a constant factor. Dissert. Abstr.

N68-36229# California Univ., Berkeley. Lawrence Radiation Lab.
TWO-NUCLEON TRANSFER REACTIONS
Norman K. Glendenning Apr. 1968 17 p refs Presented at the Meeting of the Am. Phys. Soc., Washington, D. C.
(Contract W-7405-eng-48)
(UCRL-18225; CONF-680439-1) CFSTI: HC $3.00/MF $0.65

Qualitative features of two nucleon transfer reactions are discussed. The role of the residual interaction and the single-particle spectrum in distributing the transition strength is emphasized, showing how, among states of the same spin, it is sometimes concentrated into the lowest states while other times is spread over several states. The validity and success, under appropriate circumstances, of the simple direct mechanism is illustrated. In some situations higher-order effects are expected to play a dominant role. A novel means of including the effects of core excitation on transfer reactions in a practical calculation is outlined. Author (NSA)

N68-36257# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
A THEORETICAL STUDY OF THE INTERPRETATION OF EMISSION-ABSORPTION INTENSITY RATIO TEMPERATURE MEASUREMENTS IN THE ABSENCE OF THERMAL EQUILIBRIUM
A. P. Blom and N. H. Pratt Jul. 1968 45 p refs
(AASU-286)

Emission–absorption intensity ratio temperature measurements of diatomic molecules under thermal nonequilibrium conditions are investigated theoretically. It is shown that the rotational population distribution must be taken into account when a small part of a vibration–rotation band is viewed in experiments for measuring a vibrational temperature. The rotational temperature dependence is explained in terms of transitions taking place in vibration–rotation bands, and this dependence decreases when a larger part of a band is viewed. Emission–absorption measurements are also investigated for cases where the vibrational population distribution deviates from Boltzmann, for polyatomic and for molecular electronic spectra. Finally it is shown that, in principle, both rotational and vibrational temperatures may be determined from two simultaneous emission–absorption measurements. Author

N68-36266 Michigan Univ., Ann Arbor.
INTERACTIONS OF COSMIC RAY NUCLEAR ACTIVE PARTICLES IN IRON AT MOUNTAIN ALTITUDE
John William Koch (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17798

Nuclear interactions of particles of an average energy of 100 BeV were observed by means of a 60-in. cloud chamber operated at an atmospheric depth of 530 g/cm^2. The cloud chamber contained 168 g/cm^2 of iron in the form of 17 plates each 1/2-in. thick. The cloud chamber was located at the center of the BASJE extensive air shower array on Mt. Chacaltaya, Bolivia. A coincidence requirement selected charged particles which interacted in the iron. The detectors of the BASJE extensive air shower array were placed in anticoincidence to provide a bias against interacting particles which were accompanied by air showers. Below the cloud chamber was the BASJE 60-m^2 array of detectors shielded by 320 g/cm^2 of lead and concrete. The pulses from these detectors are a measure of the energies of the interacting particles. From the relative number of interactions in each plate, the interaction mean free path of charged nuclear active particles in iron of average energy 100 BeV is calculated to be 116 ± 18 g/cm^2. Dissert. Abstr.

N68-36308 California Inst. of Tech., Bishop.
BOOTSTRAP THEORY AND CERTAIN PROPERTIES OF THE HADRON AXIAL VECTOR CURRENT
George Frederick Chapline, Jr. (Ph.D. Thesis) 1967 53 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17059

The matrix element $\langle\Omega^-|j^A_\mu|\Xi^0\rangle$ is calculated. A similar calculation for $\langle\Delta|j^A_\mu|N\rangle$ is compared with experiment. The relationship of the Goldberger–Treiman relation to the bootstrap principle is discussed. Approximate symmetry predictions for the axial vector current are compared with the S-matrix calculations. Implications of the bootstrap principle for equal time commutators of hadron currents are discussed. Dissert. Abstr.

N68-36309 Texas A&M Univ., College Station.
COUPLED-CHANNEL SCHROEDINGER EQUATION MODEL FOR NEUTRON-ALPHA AND DEUTERON–TRITON SCATTERING
William Brian de Facio (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-16454

The two body states of neutron-alpha and deuteron-triton scattering have been treated using rearrangement collision theory as formulated by R. G. Newton. The 3/2 + excited state of He^5 is explained as a strong coupling threshold effect instead of a resonance. In addition to the potential model studied, multichannel complex phase shifts are calculated for the n+α and d+T systems simultaneously. The result of extensive calculations to most of the existing data are presented and discussed. A good fit to all the data is obtained. Dissert. Abstr.

N68-36325 California Inst. of Tech., Pasadena.
COLLISIONLESS ABSORPTION AND EMISSION OF ELECTROMAGNETIC WAVES BY A BOUNDED PLASMA
Frederick Lee Hinton (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17063

The absorption and emission of electromagnetic waves by a hot bounded plasma can be greatly influenced by the collective behavior of the plasma. A homogeneous slab model of a hot plasma is used in a theoretical study of these collective effects. A boundary-value problem is solved to find the fields in the plasma when a plane wave is incident on the plasma boundary. Power is found to be absorbed from the incident wave because of the Landau damping of longitudinal plasma waves excited in the plasma. If the incident wave frequency is close to one of the plasma wave resonance frequencies, the absorption may be substantial, but only if the Landau damping rate is approximately matched to the radiation field. Emission and absorption are related by Kirchhoff's law for a thermal plasma. For a nonthermal plasma and emission may be enhanced if there are many electrons in a high-energy tail of the distribution function. Dissert. Abstr.

N68-36335# Brussels Univ. (Belgium).
THEORY OF MANY BODY PROBLEM AND PARTICLE PHYSICS Final Scientific Report, 1 Nov. 1965–31 Oct. 1967
R. Brout, F. Englert, and C. DeDominicis Jan. 1968 13 p refs
(Grant AF EOAR-65-91)
(OSR-68-1741; AD-673507)

A theoretical investigation was carried out in two areas.: (a) Elementary particle theory along the lines of bootstrap theory, axial vector renormalization, Gell-Mann Okubo mass formula and PCAC, possible spontaneous breakdown of SU3, current algebra and partial symmetry. (b) Application of many body theory to theory of ferroelectricity, fluctuation driven spin waves, and the Onsager reaction field and molecular field theory. Author (TAB)

N68-36337# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPIN RELATED POLARIZATION EFFECT IN COMPTON SCATTERING OF RELATIVISTIC ELECTRONS
Ching-Fa Lu 3 Nov. 1967 9 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 11, 1965 p 1927–1931
(FTD-HT-67-394; AD-673841)

In the production of high energy photons from Compton scattering of particles by relativistic electrons, the inclusion of particle spin may significantly increase the scattering cross section and the degree of polarization. This paper studies the effect of various possible spin states on Compton scattering by relativistic electrons. The equation of differential cross section can be written according to the transition probability of particles. In the case of charged particles with longitudinal spin (spin parallel to direction of motion), an equation of energy distribution for secondary photons is derived. Calculation shows that the scattering cross section for the production of polarized high energy photons may be twice as large for particles with directional spin as for spinless particles. In the case of charged particles with transverse spin (spin perpendicular to direction of motion), the higher order approximations disappear in the relativistic case. Using a final state summation procedure, the scattering cross section equation for transverse spin charged particles can be easily reduced to the common Klein-Nishina formula for stationary electrons. Effected by the transverse spin, the scattered photons become partially or completely polarized despite the non-polarization of the primary photons. Author (TAB)

N68-36359 Virginia Univ., Charlottesville.
ANGULAR CORRELATION MEASUREMENTS ON BORON 11 (DEUTERON, PROTON GAMMA) BORON 12 (0.95) TO TEST SYSTEMATICS OF DEUTERON STRIPPING
Andrew Pitman Borden (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17590

Angular correlations (p-γ from $B^{11}(d,p\gamma)B^{12*}_{0.95}$ have been measured in order to test the character of the (d,p) reaction mechanism under variations in the distance (D) to the pole for deuteron stripping. Angular distribution measurements on this reaction have previously been shown to be characterized by an approximately constant $D = D(E_d, \theta_{dp})$, below which the distribution data can be fit by PWBA theory and above which PWBA theory

fails to fit. Ten reaction plane angular correlations were measured in the deuteron energy range 1.0 to 5.5 MeV. The correlation symmetry axis positions were found to systematically tend toward PWBA predictions for decreasing D but the anisotropies failed to follow this trend. It is not clear that a reduction of Coulomb distortions is theoretically expected as D gets lower and it appears more realistic to expect the correlation parameters to converge on CWBA (Coulomb Wave Born Approximation) predictions. Under the assumption that DWBA stripping theory is applicable, the ratio of reduced widths for neutron capture $x = \theta_{1/2}/\theta_{3/2}$ has been shown to be positive and bounded as $0.1 < x < 8$. Dissert. Abstr.

N68-36360 California Univ., Los Angeles.
LAMBDA HYPERON BINDING ENERGY IN NUCLEAR MATTER
Alice Yuan-Ning Lou (Ph.D. Thesis) 1967 164 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-237

The experimental studies of the binding energy (B_Λ) of heavy hypernuclei ($16 < A \leq 100$) produced by the interactions of 800 MeV/c K^--mesons with the heavy nuclei (Ag and Br) of nuclear emulsions are described. Both K2 and K5 nuclear emulsions are used in the present study. A Monte Carlo calculation based on the assumption that these hypernuclei are the spallation products of K^- interactions with the heavy nuclei of the emulsion has been carried out. The production features predicted from this calculation are in good agreement with those observed experimentally except for the range distribution of heavy hypernuclei. A Saxon-well potential was assumed in the present attempt to obtain a well-depth D_Λ as close to the true value as possible. D_Λ was found to be approximately (27 ± 2) MeV. The saturation of the binding energy of the Λ-hyperon in heavy hypernuclei is found to occur very gradually. Dissert. Abstr.

N68-36391# Air Force Systems Command, Wright-Patterson, AFB, Ohio. Foreign Technology Div.
PROBABILITY OF ELECTRON TRANSITIONS OF ATOMS IN NONHOMOGENEOUS ELECTRICAL FIELDS WITH ARBITRARY ANGULAR DEPENDENCE. NEW METHOD OF CALCULATION [VEROYATNOSTI ELEKTRONNYKH PEREKHODOV ATOMOV V NEODNORODNYKH ELEKTRICHESKIKH POLYAKH S PROIZVOLNOI UGLOVOI ZAVISIMOSTYU NOVYI METOD RASCHETA]
V. M. Buimistrov Oct. 1967 21 p refs Transl. into ENGLISH from Lietuvos Fiz. Rinkinys (Lithuanian SSR), v. 3, no. 1, 1963 p 93–104
(FTD-MT-66-144; AD-673460)

The probability of electronic transitions is determined for a H atom in a weak, const., nonhomogeneous electric field. This method gives the same results as those obtained by the first approxn. of the perturbation theory with respect to the potential energy of the atom in this field, and this method does not encounter any of the difficulties of the usual perturbation method. The method is also applicable to more complex atoms. An independent proof is presented of the correctness of the results obtained by this method. TAB

N68-36450 Stanford Univ., Calif.
A PARTIAL WAVE BOOTSTRAP CALCULATION FOR ELASTIC PION–PION SCATTERING
Charles Franklin Kyle (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17452

An equation is derived which expresses crossing symmetry in terms of partial wave quantities. The equation involves a sum over partial waves which converges inside a usable part of the physical region and has the properties that the correct threshold behavior for the partial wave amplitudes is automatic. The driving forces show no high energy divergence if one stays inside the region of convergence of the partial wave summation. Coupled with the N/D equations for unitarity in the partial waves this equation forms the basis for a solution to the pion–pion bootstrap problem within the framework of S-matrix theory. Dissert. Abstr.

N68-36473# Brookhaven National Lab., Upton, N. Y.
RADIO FREQUENCY MEASUREMENTS OF ELECTRIC AND MAGNETIC MOMENTS OF NUCLEI
Victor W. Cohen 24 Jun. 1968 35 p refs Presented at the AMPRE Colloq., Grenoble, France, 16–20 Sep. 1968 Sponsored by AEC
(BNL-12628; CONF-680901-1) CFSTI: HC $3.00/MF $0.65

The various methods of investigating nuclear electric and magnetic moments are briefly discussed, and some recent developments in the field are outlined. NSA

N68-36538# Maryland Univ., College Park.
YUGOSLAV SUMMER SCHOOL LECTURE NOTES ON HARTREE–FOCK THEORY, 1967
Carl A. Levinson 1967 21 p refs
(Contract AT(40-1)-3491)
(TID-24142) CFSTI: HC $3.00/MF $0.65

The nuclear Hartree–Fock approximation is reviewed with emphasis on the calculation of the single-body Hamiltonian in terms of a given two-body potential. NSA

N68-36540# Rensselaer Polytechnic Inst., Troy, N. Y.
RECENT LOW ENERGY INELASTIC SCATTERING RESULTS FOR METAL HYDRIDES AND URANIUM CARBIDE
S. S. Pan, M. L. Yeater, and W. E. Moore (Knolls Atomic Power Lab., Schenectady, N. Y.) 1967 11 p refs Presented at the 2nd Symp. on Mater. Res.: Mol. Dyn. and Struct. of Solids, Gaithersburg, Md.
(Contract AT(30-3)-328)
(RPI-328-101; CONF-671028-4) CFSTI: HC $3.00/MF $0.65

Measurements of the inelastic scattering of neutrons by metal hydrides were made using the RPI-KAPL neutron spectrometer. The data studied include room temperature measurements of ZrH_x (x variable), NbH and TiH_2. Measurements were completed also for NbH and ZrH_2 at liquid nitrogen temperature. Incomplete data were obtained for thorium and yttrium hydrides. For zirconium hydride, the dependence of optical level width on sample temperature, momentum transfer and concentration of hydrogen was studied. NbH data exhibit a doublet at 0.12 and 0.164 eV which is believed to arise from splitting of the 1–0 transition in the optical band into transverse and longitudinal modes. New evidence was obtained for NbH regarding the relative weight of acoustic and optical modes in the frequency distribution. In general, the frequency distributions can not be approximated by simple Einstein oscillators. Author (NSA)

N68-36542# California Inst. of Tech., Pasadena.
DETERMINATION OF ELECTRONIC ENERGY LEVELS OF MOLECULES BY 90° LOW ENERGY ELECTRON SCATTERING
Pax Samuel Pin Wei (Ph.D. Thesis) 10 Oct. 1967 282 p refs Sponsored in Part by AEC
(CALT-532-20) CFSTI: HC $3.00/MF $0.65

A review of the theory of electron scattering indicates that low incident beam energies and large scattering angles are the favorable conditions for the observation of optically forbidden

transitions in atoms and molecules. An apparatus capable of yielding electron impact spectra at 90° with incident electron beam energies between 30 and 50 electron volts is described. The resolution of the instrument is about 1 electron volt. Impact spectra of thirteen molecules have been obtained. Known forbidden transitions to the helium 2^3S, the hydrogen $b^3\Sigma^+_u$, the nitrogen $A^3\Sigma^+_u$, $B^3\pi_g$, $a^1\pi_g$ and $C^3\pi_u$, the carbon monoxide $a^3\pi$, the enthylene $\tilde{a}^3B_{1u}$, and the benzene $\tilde{a}^3B_{1u}$ states from the corresponding ground states have been observed. In addition, singlet-triplet vertical transitions in acetylene, propyne, propadiene, norbornadiene and quadricyclene, peaking at 5.9, 5.9, 4.5, 3.8, and 4.0 eV (±0.2 eV), respectively, have been observed and assigned for the first time. Author (NSA)

N68-36573*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

COSMIC RAY GROUP, THEORETICAL GROUP, LINEAR ACCELERATOR GROUP, AND OTHER PHYSICS GROUPS

Progress Report, 1 Oct. 1966–1 Oct. 1967

1 Oct. 1967 49 p refs

(Contracts NASw-37; NAS5-3205; NASA-2053; AT(30-1)-2098; AF 19(628)-2389)

(NASA-CR-96099; PR-75; MIT-2098-422) CFSTI: HC $3.00/MF $0.65 CSCL 20H

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N68-36575*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

ACCELERATOR PHYSICS COLLABORATION

In its Phys. 1 Oct. 1967 p 10–12 refs (See N68-36573 23-24)

A brief report is presented on the problems involved in the accelerator physics research program, construction plans for the 500 liter bubble chamber, and the checkout of a prototype computer controlled line segment (PEPR) for scanning and measuring photographs of bubble chamber tracks. M.G.J.

N68-36576*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

LINEAR ACCELERATOR GROUP

In its Phys. 1 Oct. 1967 p 13–21 refs (See N68-36573 23-24)

It is reported that the design of the 180° electron scattering magnet for use with the electron linac and electron spectrometer was completed; the construction status of the 400 MeV linac project is also mentioned. Graphical data are presented on the angular distribution of the polarization of elastically scattered fast neutrons, and on measurements of distribution in energy and angle of high energy protons emitted in the photodisintegration of Li^6. M.G.J.

N68-36577*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

HIGH ENERGY ACCELERATOR GROUP

In its Phys. 1 Oct. 1967 p 22–42 refs (See N68-36573 23-24)

Various experiments conducted on photoproduction and photoproduction cross section measurements are listed, along with experiments on the $\pi^+\pi^-$ mass spectrum, forward π–p charge exchange in the 2 to 6 GeV region, K^-–induced final states containing a single V-particle, dikson resonances, and $\Delta S/\Delta Q$ tests. It is reported that the internally tagged photon beam is working, and that work on π^- charge exchange is being completed. An overview is presented on photon experiments conducted to determine the proton Compton effect, recoil polarization in π^0 photoproduction, and lambda polarization in K^+ photoproduction. Four experiments, based on spark chamber photographs of about 100,000 decay events of K^+ mesons at rest, are discussed. M.G.J.

N68-36578*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

O.N.R. GENERATOR GROUP

In its Phys. 1 Oct. 1967 p 43–68 refs (See N68-36573 23-24)

In studying the wide variety of nuclei, ranging from sulfur to tellurium, the reactions used involved stripping or pickup so that the results could be analyzed to obtain spin and parity assignments and the spectroscopic strengths of the individual levels. The doubly charged He^3 beam was used in most experiments with attention given to those nuclei in the first $f_{7/2}$ shell. Preliminary results are summarized for even parity states in Ca^{41} and Ca^{43}, and for (He^3,d) reactions on even nuclei and on odd nuclei. Also reviewed are findings on the gamma decay modes of the excited states in Ti^{47} and Cr^{53}, neutron pickup reactions, (He^3,p) reactions, the $Fe^{57}(d,p)Fe^{58}$ reaction, (He^3,p) reactions on nickel isotopes, the $Co^{59}(He^3,p)Ni^{61}$ reaction, the $P^{31}(He^3,d)S^{32}$ and $P^{31}(He^3,p)S^{33}$ reactions, and the $Zn^{66}(d,p)Zn^{67}$, $Zn^{67}(d,d')Zn^{67}$, and $Zn^{67}(p,p'\gamma)Zn^{67}$ reactions. The analogue states of Sr^{89} are depicted, along with the energy levels of Ag^{108} from the $Ag^{107}(d,p)Ag^{108}$ reaction. Range energy measurements for heavy ions in nuclear emulsions are reported, and mention is made of instrumentation designs and test facility construction. M.G.J.

N68-36579*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

RADIOACTIVITY GROUP

In its Phys. 1 Oct. 1967 p 69–93 refs (See N68-36573 23-24)

Summary data are presented on the following research programs: (1) The ion implantation perturbed angular correlation technique (IMPACT) was used to investigate the perturbed angular correlations of Coulomb-excited gamma rays. The magnetic moments of first 2+ states of mercury and platinum isotopes were measured. It is reported that investigations of the internal fields of nuclei of various solutes in iron, nickel, cobalt, and gadolinium led to the discovery of an induced polarization of heavy ions which traverse polarized ferromagnetic domains. (2) Perturbed angular correlation of gamma–gamma cascades was used to study internal magnetic fields at dilute impurities in iron and to measure the g-factors of short-lived excited states of nuclei using these internal fields. (3) The Mossbauer effect was used to study isomer shifts, and measurements were made of the change in charge radius between members of the rotational band in Eu^{153}, as well as several even–even nuclei. (4) Based on IMPACT, nuclear reactions were used to measure magnetic moments; g-factors of other states in ferromagnetic materials were also measured. (5) Perturbed angular correlations were used for measurements of states fed by alpha particle decay. M.G.J.

N68-36580*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
CYCLOTRON GROUP
In its Phys. 1 Oct. 1967 p 95-105 refs (See N68-36573 23-24)

An overview is presented on cyclotron operation and equipment, and on several gamma ray experiments. Depicted and discussed are findings on the Doppler shift for a γ-ray transition in Ca^{44}; experimental transition rates (in single particle units) for 2^+ and 4^+ states in Zr^{90} and Mo^{92}; experimental and theoretical transition rates (in single particle units) for 3^- states in Zr^{90} and Mo^{92}; elastic scattering of 28.9 MeV α particles from Ca^{40} and Ca^{48}; deuteron spectrum from the $Pb^{208}(p,d)Pb^{207}$ reactions at 30° lab; and deuteron spectrum from the K^{39} (α,d) reaction at 35° lab. M.G.J.

N68-36581*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
THEORETICAL GROUP
In its Phys. 1 Oct. 1967 p 106-142 refs (See N68-36573 23-24)

An overview is presented on the research being conducted in the areas of nuclear physics theory and particle theory, and abstracts on each project are included. These pertain to nuclear forces; nuclear structure and nuclear forces; models and the Hartree-Fock approximation; scattering and nuclear reaction mechanisms; parity nonconservation in strong interactions; quark model; angular momentum plane; current algebra, partial conservation of axial current, and soft pion phenomena; phenomenological approaches; quantum electrodynamics and field theory; and the three-body problem. M.G.J.

N68-36626# Grenoble Univ. (France).
ANALYSIS OF INTERNAL CONVERSION ELECTRON GROUPS [ANALYSE DE GROUPES D'ELECTRONS DE CONVERSION INTERNE]
Harouna Traore [1966] 24 p refs In French
(NP-17225)

The β spectrometer and techniques used for the analysis of the internal conversion electrons of ^{231}Th and ^{155}Eu are described in detail. The sources used made it possible to record the L- and M-conversion electrons of the 58.5-keV transition of ^{231}Th. The results showed that the transition can be considered as pure E2. As the number of M-conversion electrons was very low, no conclusions could be made as to the nature of the transition. The study of the ^{155}Eu internal conversion electrons confirmed the nature of the 86.5- and 59.95-keV transitions previously obtained. A L_1 ray of a weak transition at 85.9 keV and an M group at 59.95 keV were detected. NSA

N68-36633# Columbia Univ., Irvington, N. Y. Nevis Labs.
SEARCH FOR THE INTERMEDIATE BOSON OF THE WEAK INTERACTIONS
John Sunderland (Ph.D. Thesis) 1967 123 p refs
(Contract AT(30-1)-1932)
(NEVIS-164; CU-268; R-605) CFSTI: HC $3.00/MF $0.65

A search for the intermediate boson proposed to mediate the weak interactions was carried out in two experiments performed with the fast extracted beam at the AGS. The weak plus electromagnetic production process: ν_μ + nucleus → W + μ + nuclear products, W → e + ν_e was studied in an aluminum spark chamber array. No events corresponding to the prompt muon and the decay electron were seen. On the basis of the calculated cross section and a measurement of the neutrino flux, it can be concluded that $m_W \geq (2.0 \pm 0.1)\, m_p$ assuming a 50% branching ratio into the leptons. The search was extended with a counter experiment designed to detect wide angle muons from the reaction sequence: p + tungsten → W + nuclear products, W → μ + ν_μ. The use of a target with short interaction length supplemented by a steel shielding wall suppresses the contribution of muons from the decays of pions and kaons as well as the background of hadrons. The absence of wide angle muons in excess of those predicted from π and K decays permits the conclusion that if the W has mass between 2 and 6 BeV/C^2, the cross section for the above production reaction is less than $\approx 10^{-33}$ cm^2. Author (NSA)

N68-36634# Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark).
MANY-BODY PROBLEMS. VOLUME 2. LECTURES GIVEN AT THE NIELS BOHR INSTITUTE AND NORDITA
G. E. Brown 1967 198 p refs
(NP-17258)

Four lectures are included on the following: (1) random phase approximation, (2) Landau theory of Fermi liquids, (3) phonons and electrons, and (4) theory of superfluidity. NSA

N68-36639# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
MULTIPLE SCATTERING CORRECTION TO THE AVERAGE ENERGY LOSS OF HEAVY PARTICLES
C. Tschalaer and H. Bichsel Oct. 1967 40 p refs
(RHEL/R-153) CFSTI: HC $3.00/MF $0.65

The mean increase in energy loss $\delta\overline{T}_m$ due to multiple scattering of heavy particles is treated for thick absorbers. Using Molière's theory with the improvement by Nigal et al., the mean square and mean fourth power of the reduced scattering angle is calculated for all absorber materials, for incident energies larger than a few MeV, for energy losses up to 80% of the incident energy, and for circular detectors with angles of acceptance up to ±35 degrees. A method is given for computing the mean energy correction $\delta\overline{T}_m$ from the incident and outgoing energies, from the stopping power in the absorber, and from the detector angle of acceptance. A typical value for $\delta\overline{T}_m$ of 649 keV is obtained for 40 MeV protons losing 32 MeV in gold absorber and being seen under a detector angle of ±29 degrees. Author

N68-36653*# Ohio State Univ., Columbus. ElectroScience Lab.
LIFETIME AND TRANSITION PROBABILITIES OF $np^4(n+1)p$ STATES OF Ne 2, A 2, AND Kr 2
S. H. Koozekanani and G. L. Trusty 17 Sep. 1968 14 p refs
(Grant NsG-74-60)
(NASA-CR-97198; Rept.-1093-42) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Lifetime as well as transition probabilities of the first p-excited states of neon+, argon+, and krypton+ for the configuration of $np^4(n+1)p$, have been calculated. This information is needed to determine the possible efficiencies of current and proposed laser systems and to aid in the identification of the energy levels involved. Author

N68-36662# Illinois Univ., Urbana. Dept. of Physics.
THE REACTION $K^-p \rightarrow K^-\pi^+\pi^-p$ AT 4.1 AND 5.5 GeV/c
S. Kim, J. C. Park, G. Chandler, G. Ascoli, and E. L. Goldwasser 22 Dec. 1967 29 p refs Presented at the 3rd Topical Conf. on Resonant Particles, Athens, Ohio
(Contract AT(11-1)-1195)
(COO-1195-111; CONF-671122-3) CFSTI: HC $3.00/MF $0.65

The reaction $K^- + p \rightarrow K^- + \pi^+ + \pi^- + p$ at 4.1 and 5.5 GeV/c in a hydrogen bubble chamber was studied. It was observed that his reaction is dominated by $K^*(890)$ and $N^{*++}(1236)$ production at both energies. Asummary of cross sections for different resonance channels lead to the studied

reactions is given. A study of the absorptive peripheral model as applied to the reaction $K^- + p \rightarrow K^{*0} + N^{*0}$ is made, and an account of the $K^{*0}\pi^-$ system is given. NSA

N68-36684# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
EXACT DETERMINATION OF THE COULOMB AMPLITUDE BY S-MATRIX METHODS
X. Artru, M. Fontannaz, and R. Omnes Jul. 1968 40 p refs
(Rept.-68/19) CFSTI: HC $3.00/MF $0.65

An extension of the S-matrix methods to the case of the exchange of zero-mass particles allows the determination of the Coulomb scattering amplitude and the levels of the hydrogen atom completely. Starting from the special analytic properties in t due to the zero mass of the photon, and writing amplitude as an entire function of $\ln t$, two main assumptions are: (1) the amplitude is exponential with respect to $\ln t$; and (2) the partial wave amplitude has only Regge poles in l. There are several classes of solutions. One is the Schrödinger solution. The others lead to ghosts or to bound states in the e+p system and are therefore discarded. The same method can be extended to the nonrelativistic problem with spin and leads to the same result as in the case without spin. In the relativistic case, results disagree with the Dirac and Klein–Gordon solutions. Author

N68-36685 California Univ., Berkeley.
POLARIZATION CORRELATION OF PHOTONS EMITTED IN AN ATOMIC CASCADE
Carl Alvin Kocher (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-95

Observations of the correlation in linear polarization of two photons emitted successively in an atomic cascade are described. Calcium atoms in an atomic beam are excited optically ($4^1S_0 \rightarrow 6^1P_1$) by ultraviolet continuum radiation from a high-intensity low-voltage H_2 arc lamp. Photon pairs emitted in the cascade $6^1S_0 \rightarrow 4^1P_1 \rightarrow 4^1S_0$ (5513Å and 4227Å) are detected by conventional photomultipliers fitted with rotationable linear polarizers of the Polaroid type. The coincidence counting rate, recorded by a time-to-height converter and multichannel pulse-height analyzer, is found to be consistent with the theoretical correlation $(\hat{\epsilon}_1 \cdot \hat{\epsilon}_2)^2$, where $\hat{\epsilon}_1$ and $\hat{\epsilon}_2$ denote the observed linear polarizations. Dissert. Abstr.

N68-36688 California Inst. of Tech., Pasadena.
AN INVESTIGATION OF SPONTANEOUS BREAKDOWN OF SU(3) SYMMETRY IN THE SYSTEM OF PSEUDOSCALAR MESON AND BARYON OCTETS
Ivo Tammaru (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17075

The system of pseudoscalar meson and baryon octets is examined for spontaneous breakdown of SU(3) symmetry in a bootstrap theory with vanishing renormalization constants. The latter are calculated in second order perturbation theory; the splittings are taken to retain SU(2) symmetry and are included to first order only. The equations are diagonalized in the dimension of the representations. The F-D mixing parameter α is found to have the value 3/4. The system shows great instability in the 8 representation, and two solutions exist for not unreasonable values of the coupling constant and the meson-baryon mass ratio; one of the solutions has the observed relative signs for the mass splittings and exhibits a coupling splitting pattern found by other workers. A solution exists in the 27 representation with a coupling constant squared which is two orders of magnitude too large. Dissert. Abstr.

N68-36691 Brigham Young Univ., Provo, Utah.
THE MEASUREMENT OF THE GYROMAGNETIC RATIO OF THE FREE ELECTION: A FEASIBILITY STUDY
Martell J. Gee (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-17218

The attempts to measure the gyromagnetic ratio of the free electron are reviewed and criteria are presented which must be met by any successful measurement of g. A novel method of obtaining an initial asymmetry in the spin populations of an electron beam is proposed, and its use in an experiment designed to measure g is discussed. Apparatus has been built in order to carry out such a measurement. Preliminary experiments carried out in this apparatus are reported and discussed, and suggestions for completion of the experiment are given. Dissert. Abstr.

N68-36692 California Inst. of Tech., Pasadena.
SUPERNOVAE EXPLOSIONS INDUCED BY PAIR PRODUCTION INSTABILITY
Gary Scott Fraley (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-14347

Stars with a core mass greater than about 30 $M_\odot$ become dynamically unstable due to electron-positron pair production when their central temperature reaches $1.5 - 2.0 \times 10^{9}$°K. The collapse and subsequent explosion of stars with core masses of 45, 52, and 60 $M_\odot$ is calculated. The range of the final velocity of expansion (3,400–8,500 km/sec) and that of the mass ejected (1–40 $M_\odot$) is comparable to that observed for type II supernovae. An implicit scheme of hydrodynamic difference equations (stable for large time steps) used for the calculation of the evolution is described. For fast evolution the turbulence caused by convective instability does not produce the zero entropy gradient and perfect mixing found for slower evolution. A dynamical model of the convection is derived from the equations of motion and then incorporated into the difference equations. Dissert. Abstr.

N68-36693# Naval Research Lab., Washington, D. C.
A TABLE OF CENTRAL-FORCE GEOMETRICAL COEFFICIENTS ASSOCIATED WITH TALMI INTEGRALS FOR USE IN CALCULATING NUCLEAR TWO-BODY MATRIX ELEMENTS USING HARMONIC OSCILLATOR WAVE FUNCTIONS Interim Report
J. B. Langworthy and S. Podgor 7 Jun. 1968 61 p
(NRL-6733; AD-673524)

In calculating nuclear two-body matrix elements using harmonic oscillator wave functions, the radial parts give Talmi integrals and the angular parts may be done by Racah algebra, yielding the geometrical coefficients tabulated here. This table is calculated from the harmonic oscillator transformation brackets and B coefficients of Moshinsky. The table is applicable to the calculation of central-force matrix elements for nuclides containing up to 70 nucleons of a single species and is accurate to at least seven significant figures. Author (TAB)

N68-36698 Nebraska Univ., Lincoln.
R(11) SYMMETRY AS AN ALTERNATE TO SU(6) SYMMETRY FOR ELEMENTARY PARTICLES
Larry Lee Smalley (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-754

Predictions of R(11) symmetry are compared to those of SU(6) symmetry. Assuming the structure of the baryonic weak currents to be given by the regular representation with the baryons in 32 for R(11) and in 56 for SU(6) yields values of f_A in good agreement with experiment for R(11), but in bad agreement for

SU(6). On the other hand, current commutation relations of time components of the strangeness changing and non-changing axial-vector currents yield two values of f_A both in good agreement with experiment for SU(6), but both in bad agreement for R(11). Admixtures of different representations with the 56 in SU(6) can correct the poor value of f_A obtained from assuming a structure for the currents without changing the good values obtained from current commutation relations, since the commutators are equal to linear combinations of hypercharge and the third component of isotopic spin, both physically observable quantities. Dissert. Abstr.

N68-36711 California Univ., Berkeley.
CLASSICAL AND QUANTUM FIELD-THEORETIC DERIVATIONS OF GRAVITATIONAL THEORY
Edward Polk Tryon (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-171

Sets of postulates are presented for the classical and quantum theories of gravitation. Implications of these postulates are studied for the Lagrangian and Hamiltonian, respectively. Quantum electrodynamics experience suggests that radiative gravitational energy corresponds to massless bosons of a unique spin, which we shall call gravitons. We assume the graviton to have a spin of two. Investigation of the classical theory is within the framework of flat-space, Lorentz-covariant, local Lagrangian field theory. Gravitation is represented by a real second-rank symmetric tensor field $\psi^{\mu\kappa}(x)$, and matter by a real scalar field $\phi(x)$. Investigation of the quantum theory is within the framework of Interaction Picture perturbation theory. Our results are precisely those of Einstein's theory, as quantized by Gupta and Feynman. Dissert. Abstr.

N68-36722# RAND Corp., Santa Monica, Calif.
THE INVARIANT IMBEDDING NUMERICAL METHOD FOR FREDHOLM INTEGRAL EQUATIONS WITH SEMIDEGENERATE KERNELS
R. E. Kalaba and B. J. Vereeke Aug. 1968 42 p refs
(Contract F44620-67-C-0045)
(RM-5694-PR; AD-673473)

A method using invariant imbedding is given for converting Fredholm integral equations with semidegenerate kernels into equivalent initial-value problems that can be solved effectively by analog or digital computers. In this formulation of the initial-value problem the interval length is viewed as an essential variable. A proof is given showing that the solution of the initial-value problem yields a solution of the Fredholm integral equation. Results of test calculations are presented, as well as a FORTRAN program. Author (TAB)

N68-36750# Illinois Univ., Urbana.
DIFFERENTIAL CROSS SECTIONS FOR THE REACTION HELIUM 4 (GAMMA, PROTON) HYDROGEN 3 FROM 55 TO 165 MEV
Charles Gustave Stenberg (Ph.D. Thesis) 1968 122 p refs
(Contracts AT(11-1)-1195; Nonr-1834(05); Grant NSF GP-2799)
(COO-1195-131) CFSTI: HC $3.00/MF $0.65

Differential cross sections were measured for the reaction $^4He(\gamma,p)^3H$ for incident photons of 55 to 165 MeV. Outgoing protons and tritons from a low-temperature ^4He target were detected in coincidence at three angular settings in the laboratory: (θ_p, θ_t) = (59.5, 106°), (88.5°, 75°), and (118°, 47.5°). The triton detection system consisted of three semiconductor detectors followed by a plastic scintillator. The proton detection system consisted of four plastic scintillators and was large enough to collect all protons correlated with tritons in the triton system. The pulses from the calibrated detectors were used to identify the particles and measure their energies. The results show an exponential decrease in the differential cross sections with increasing gamma-ray energy with possible leveling off at the region of pion threshold. The angular distribution of the protons is peaked more strongly forward as the energy increases. Author (NSA)

N68-36752# California Univ., Berkeley. Lawrence Radiation Lab.
A MEASUREMENT OF THE POSITIVE KAON BRANCHING RATIOS $K^+_{\mu 2}$, $K^+_{\pi 2}$, $K^+_{\pi 3}$, $K^+_{\mu 3}$
Ned Dairiki (Ph.D. Thesis) May 1968 91 p refs
(Contract W-7405-eng-48)
(UCRL-18245) CFSTI: HC $3.00/MF $0.65

Mesons (K+) in a separated momentum-analyzed beam were brought to rest in a scintillator target which served as a source point for a broad-range magnetic spectrometer. Pions, muons, and electrons from the various decay modes of the K+ were identified by range and momentum and a measurement of the relative branching ratios ($K^+_{\mu 2}$, $K^+_{\pi 2}$, $K^+_{\pi 3}$, $K^+_{\mu 3}$) was made. Using a compiled branching ratio value for the ($\tau + \tau'$) modes of (7.26 ± 0.09)% the resulting values of the branching ratios were: $K^+_{\mu 2}$ (63.4 ± 0.99)%, $K^+_{\pi 2}$ (21.6 ± 0.72)%, $K^+_{\mu 3}$ (3.51 ± 0.80)% and $K^+_{e 3}$ (4.12 ± 0.36)%. The measurement is compared with results of other experiments. Author (NSA)

N68-36770# New York Univ., N. Y. Radiation and Solid State Lab.
THE INTERACTION OF RADIATION WITH MATTER
Progress Report
Dec. 1967 78 p refs
(Contract AT(30-1)-2962)
(NYO-2962-6) CFSTI: HC $3.00/MF $0.65

Pauli excitation of neon atoms during collisions, measurement of stopping power of materials, and charge exchange in proton-alkali metal collisions were investigated. Channeling studies through characteristic radiations were made, and heavy particles in semiconductor detectors were studied. Current studies on energy transfer and ionization processes in inorganic and organic materials are summarized, as is research on basic processes triggered when a heavy ion penetrates matter. M.W.R.

N68-36775# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EFFECT OF THE ONE PHONON ADMIXTURES ON THE M1 AND E2 TRANSITION RATES IN I-125 AND I-127
J. Kownacki, J. Ludziejewski, and M. Moszynski 1967 20 p refs
(INR-P-812/IA/PL)

On the basis of these measurements, reduced transition probabilities, B(M1) and B(E2), were established; and the results were compared with the predictions of the single-particle model as well as with the pairing-plus-quadruple force model used by L. S. Kisslinger and R. A. Sorensen for spherical nuclei. Author (NSA)

N68-36776# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE PROPERTIES OF PAR-1 ALLOY FOR THE CONSTRUCTION OF THE CORE OF NUCLEAR REACTOR EWA 10 MW [WLASNOSCI STOPU PAR-1 PRZEZNACZONEGO NA ELEMENTY KONSTRUKCYJNE RDZENIA REAKTORA EWA 10]
B. Bochenek and L. Szulc 1967 37 p refs In POLISH; ENGLISH summary
(INR-779/XIV/PS)

The results of analysis and investigations of the physical, mechanical and nuclear properties of the wrought elements of PAR-1 alloy, for the EWA 10 MW reactor core, are described. The possibility of the use this alloy in the constructions of nuclear reactors has been confirmed. Author (NSA)

N68-36777# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
NOTE ON THE AZIMUTHAL ASYMMETRY OF THE SECONDARY PARTICLE EMISSION IN A HIGH ENERGY NUCLEAR REACTION
E. Balcer, T. Sieiarczuk, and P. Zielinski 1967 12 p refs
(INR-P-819/VI)

The azimuthal asymmetry in a class of secondaries in the 780 interactions of 9 GeV negative pions with xenon nuclei is observed. The observed asymmetry is correlated with the previously established occurrence of the p-p final state interaction in the secondary particle emission. Author (NSA)

N68-36778# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE DECAY CHAIN OF Nd-138 → Pr-138 → Ce-138 [O TSEPOCHKE RASPADA Nd-138 → Pr-138 → Ce-138]
V. S. Buttsev, Zh. T. Zhelev, V. G. Kalinnikov, A. V. Kudryavtseva, Ya. Liptak et al 1967 18 p refs In RUSSIAN
(JINR-P6-3541)

The more exact data on the decay of ^{138}Nd → ^{138}Pr → ^{138}Ce are given. It is established that by the decay of ^{138}Pr (1.5 min) the levels 0(0+), 787.1(2+), 1473.8(0+) and 1510 keV (2+) are excited in the ^{138}Ce nucleus. The mass difference of the ^{138}Pr and ^{138}Ce nuclides, determined with great accuracy, is found to be Q_{β^+} = 4437 ± 10 keV. The nature of ^{138}Ce levels is discussed. An approximate level of 326 keV, excited by the decay of ^{138}Nd in ^{138}Pr nuclei, is introduced. It is established that ^{138}Pr isomeric state (2.2 h) is by 363 ± 30 keV higher than the main state. Author (NSA)

N68-36783# United Kingdom Atomic Energy Authority, Harwell (England).
OBSERVATION OF AN ENHANCEMENT IN THE I = 0 $\pi^+\pi^-$ SYSTEM AT 1085 MEV
C. Whitehead, J. G. McEwen, R. J. Ott, D. K. Aitken, G. Bennett et al 1967 13 p refs
(RPP/H-33) CFSTI: HC $3.00/MF $0.65

Some results of an investigation of the $\pi^+\pi^-$ system produced in the reaction $\pi^-p \rightarrow \pi^+\pi^-n$ using 3.1 to 3.6 GeV/c pions from NIMROD are described. A report was submitted to the conference on High Energy Physics held at Heidelberg earlier in the year, and a complete analysis of the full experimental work will be published later. The studies described emanate from AERE, Harwell, and the Universities of London and Southampton. Author (NSA)

N68-36804# California Univ., Berkeley. Lawrence Radiation Lab.
EVALUATION AND FUTURE OF THE REGGE POLE MODEL FOR PION NUCLEON SCATTERING AT HIGH ENERGIES
William Rarita 6 Oct. 1967 7 p refs Presented at Conf. on Pion Nucleon Scattering, Irvine, Calif., 1-2 Dec. 1967
(Contract W-7405-eng-48)
(UCRL-17873; CONF-671203-1) CFSTI: HC $3.00/MF $0.65

A fairly complete analysis was previously made of π + N scattering at small momentum transfers and high energies according to the Regge pole model in which the dominant poles in the crossed channel are P, P', and ρ. New data are given on the phase of the forward scattering amplitudes for π^+ + p and π^- + p interactions after the completion of the analysis in the reference cited. These data are shown together with the calculated values obtained from solution (3) of the cited reference. NSA

N68-36813# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
STUDIES OF ELECTROMAGNETIC PROPERTIES OF EXCITED STATES OF NUCLEI
F. R. Metzger 12 Dec. 1967 16 p refs
(Contract AT(30-1)-3525)
(NYO-3525-26) CFSTI: HC $3.00/MF $0.65

Through resonance scattering experiments utilizing the γ radiation from gaseous sources, it was demonstrated that the Coulomb explosion of molecules following electron capture can provide the velocities necessary for the compensation of the γ recoil energy losses. This new technique was then used to accurately determine the strength and the multipole mixing of the 1.115-MeV transition in ^{65}Cu. Other resonance fluorescence experiments made use of the Doppler-broadened γ rays from nuclear reactions or the Doppler-shifted radiation from sources at high velocities in the Bartol High Speed Rotor Facility. Levels in ^{40}Ca, ^{64}Zn and/or ^{66}Zn, and ^{124}Te were excited. These experiments led to unambiguous spin assignments for some of these states and provided information concerning the widths of these levels. Theoretical work was performed on the isospin dependence of the electric dipole strength in nuclei as well as on the distribution of the radiative width among the fine structure states of an isobaric analog resonance. The possible influence of charge exchange collisions on a nucleon transfer reaction was studied. Transition rates of μ-capture reactions in ^{12}C were estimated, the shell-model structure of states in ^{50}Sc was calculated, and the deformation of levels in A = 14 nuclei was investigated. Author (NSA)

N68-36825# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
KAON-NUCLEON TOTAL CROSS SECTIONS FROM 0.6 TO 2.65 GeV/c
D. V. Bugg, J. D. Davies (Birmingham Univ.) and A. A. Carter (Cambridge Univ.) 1967 35 p refs
(RPP/H-31) CFSTI: HC $3.00/MF $0.65

Total cross sections of K^+ and K^- mesons on protons and deuterons were measured in a transmission experiment over the range of laboratory momentum 0.6 to 2.65 BeV/c. Measurements were made on K^- at 58 momenta at intervals of 25 to 50 MeV/c; the experimental accuracy was better than 1% above 700 MeV/c, and the momentum resolution of the beam was ±0.6%. Structure was observed in the total cross sections suggesting or confirming Y^*_1 resonances at masses of 1665, 1768, 1905, 2020, 2250, and 2455 MeV/c^2 and Y^*_0 resonances at masses of 1695, 1819, 1870, 2100, and 2340 MeV/c^2. The K^+ measurements were less extensive, and were concentrated in the momentum range below 1.5 GeV/c; the experimental errors were typically ±0.2 mb. Structure previously reported in the K^+p and K^+d total cross sections near a laboratory momentum of 1.2 GeV/c was confirmed. Total cross sections of K^+ and K^- on carbon were measured at a number of momenta with an accuracy of about ±2%. Author (NSA)

N68-36838# Oregon Univ., Eugene. Dept. of Physics.
NUCLEAR PHYSICS RESEARCH Progress Report, Year Ending 31 May 1968
31 May 1968 164 p refs
(Contract AT(45-1)-1925)
(RLO-1925-11) CFSTI: HC $3.00/MF $0.65

Neutron-yield measurements as a function of incident energy, utilizing a thick-target method, were completed for deuterons on

^{12}C and ^{16}O. The construction of shielding for neutron scattering studies is continuing, and measurements are beginning. A study of the $^{40}Ca(d,n)^{41}Sc$ reaction at energies below the Coulomb barrier was initiated. An in-place evaporator was completed, and several angular distributions were obtained. Precise gamma-ray measurements on the $^{27}Al(p,\gamma)^{28}Si$ reaction were completed. Energies, lifetimes, and branching ratios in the de-excitation of ^{28}Si excited states were investigated. A similar study of ^{40}Ca excited states was completed. The usefulness of angular-distribution measurements in capture-gamma experiments with Ge(Li) detectors is being studied through the $^{31}P(p,\gamma)^{32}S$ reaction. Work on second-order effects in β decay was extended. Internal ionization during β decay was treated theoretically as a one-step process, using relativistic wave functions and paying attention to antisymmetrization and phase-space considerations. Author

N68-36839# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
ELECTROPRODUCTION OF π MESONS [ELEKTROERZEUGUNG VON π-MESONEN]
Diethard Schmidt Jan. 1968 68 p refs In GERMAN; ENGLISH summary
(DESY-F-32/3)

In a spark chamber experiment, electroproduction of pions was studied by detecting coincidences between the scattered electron and one of the pions. The covered range of the energy q_0 of the virtual photon was $0.7 < q_0 < 3$ GeV, the range of the square of the four-momentum transfer q^2 was $0 \leq |q^2| \leq 0.1$ $(GeV/c)^2$. The measured rest-mass distribution of the unobserved system shows that at higher energies of the virtual photons multiple pion production dominates. A fit shows that these events are mainly due to electroproduction of ρ^0-mesons. In single-pion electroproduction, the dependence was measured of the square of the four-momentum transfer q^2, and of the azimuth angle between the plane defined by the virtual photon and the pion and the plane defined by the incoming and outgoing electrons. The differential cross section $d\sigma/dt$ for electroproduction of single positive pions is shown as a function of the four-momentum transfer to the recoil nucleon in the range $0.01 \leq |t| \leq 0.07$ $(GeV/c)^2$, integrated over the accepted range of q^2 and averaged over 3 intervals of q_0. In the limit $q^2 \rightarrow 0$ the given electroproduction cross section compares well with the known photoproduction cross section. Author (NSA)

N68-36846# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
WHO IS AFRAID OF W?
G. Domokos and P. Suranyi 5 Jan. 1968 15 p refs
(KFKI-1/1968)

The SL(2,C) classification of Regge trajectories is extended to nonzero energies. Regge trajectories can be classified according to a broken SL(2,C) algebra, each Regge-particle being a superposition of a few irreducible representations of SL(2,C). A mass formula is derived to describe Regge trajectories which belong to one SL(2,C) family. The Δ-family turns out to be exchange-degenerate to a good approximation. The known nucleon trajectories can be fitted into one SL(2,C) family well described by the mass formula. The mass formula predicts several new resonances, some of them without parity partners. Evidence is put forward for the existence of a new family of nucleon Regge trajectories. Author (NSA)

N68-36849# Maryland Univ., College Park, Dept. of Physics and Astronomy.
A STUDY OF FINAL STATES WITH A KAON ANTI KAON PAIR PRODUCED BY 4.25 GeV/C NEGATIVE KAON IN HYDROGEN
Gerald Stanley Abrams (Ph.D. Thesis) Sep. 1967 204 p refs
(Contract AT(40-1)-2504
(ORO-2504-109; TR-720)

Final states in which both K and $\bar{K}$ mesons are produced in hydrogen were analyzed at a K^- beam momentum of 4.25 KeV/c. A main concern of this experiment was a study of strangeness -2 baryon states. Weak evidence is presented for the detection of the ξ^* (1815) found at lower energies. The data offer no other evidence of ξ^* resonance production. The ϕ meson was found to be produced relatively copiously, both in the $\Lambda\phi$ and in the $\Sigma\phi\pi$ states. The mass and width of the ϕ was measured using the $\Lambda\phi$ events, and the results compared to other measurements. The production of the ϕ meson appears to be mediated by K and K^* exchange. Evidence was found supporting the existence of the f^0 (1500). Evidence for a $K^0_1K^0_2$ enhancement near 1600 MeV was found; the data do not demand a resonance interpretation. Formation of K^* (890), $Y^*_0(1405)$, $Y^*_1(1385)$ and $Y^*_0(1520)$ are also indicated by the data. There also exists indications that the D, E, $\pi_v(1003)$ and $\eta_v(1050)$ may be produced. The most significant results of this experiment are the lack of any outstanding structure, and the small values of the observed cross sections. Author (NSA)

N68-36854# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC RESONANCE IN ORIENTED NUCLEI
D. A. Shirley Sep. 1967 30 p refs Presented at Intern. Conf. on Hyperfine Interactions Detected by Nucl. Radiation, Pacific Grove, Calif., 25–30 Aug. 1967
(Contract W-7405-ENG-48)
(UCRL-17854; CONF-670812-17) CFSTI: HC $3.00/MF $0.65

Several new types of experiment that entail radiative detection of NMR are discussed. A brief survey of radiative detection of magnetic resonance in nuclei oriented by equilibrium methods at very low temperatures is given. A critical discussion is given of the hyperfine enhancement factor. Line shapes and resonance destruction are treated. Spin temperatures and spin-lattice relaxation are discussed. NSA

N68-36863# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
DECAYS OF 2+ MESON AND SU(6) SYMMETRY
V. V. Kukhtin 1968 8 p refs
(ITF-68-12)

The decay $2^+ \rightarrow 0^- + 0^-$ is considered for the 189 and 405, representations of the group SU(6) on the basis of SU(3) symmetry. The conclusion is drawn that the particles f, f', K^{**}, A_2 may be assigned to the 405 only. Author (NSA)

N68-36878# California Univ., Berkeley. Lawrence Radiation Lab.
SEARCH FOR THE DIRECT DECAY $K^+ \rightarrow \pi^+ + \gamma + \gamma$
M. Chen, D. Cutts, P. Kijewski, R. Stiening, C. Wiegand, and M. Deutsch 25 Oct. 1967 19 p refs
(Contract W-7405-ENG-48)
(UCRL-17887) CFSTI: HC $3.00/MF $0.65

As a part of the spark chamber study of K^+ decays at rest data was searched for examples of direct decay $K^+ \rightarrow \pi^+ + \gamma + \gamma$. This is done by means of restrictions derived from the study of exactly solvable models. Two classes of problems are considered: (a) obtaining a lower bound to the ground-state energy of a system of particles, and (b) obtaining a lower bound to the Helmholtz free energy. For the first case an exact lower bound is obtained for the ground-state energy of the particle-conserving Bogolyubov Hamiltonian. Of particular significance in the nonzero temperature case is a rigorous lower bound to the free energy of the Ising model with small external field at low temperatures. Author (NSA)

N68-38879# Los Alamos Scientific Lab., N. Mex.
ATOMIC STRUCTURE CALCULATIONS. 2: HARTREE-FOCK WAVEFUNCTIONS AND RADIAL EXPECTATION VALUES: HYDROGEN TO LAWRENCIUM
Joseph B. Mann 15 Feb. 1968 274 p refs
(Contract W-7405-ENG-36)
(LA-3691) CFSTI: HC $3.00/MF $0.65

Hartree–Fock calculations were made of the electronic structure of the elements from hydrogen to lawrencium. Exchange terms were included without approximation. Tabulations of the electron wave functions and average r^n, with seven values of n from −3 to +6, are presented. Author (NSA)

N68-38881# European Organization for Nuclear Research, Geneva (Switzerland).
THE LIMITS FOR PROTON CURRENTS IN AN ACCELERATOR TUBE WITH STRONG FOCUSING
E. A. Abramyan, V. V. Vecheslavov, and V. I. Kononov Jul. 1967 18 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Yadernoi Fiz. (Novosibirsk).
(CERN-TRANS-67-4; PS/6060) CFSTI: HC $3.00/MF $0.65

The motion of an intense proton beam in an accelerator tube with strong-focusing quadrupole lenses has been studied. The maximum current I_{max} passing through the tube is calculated as function of the phase space volume V_n occupied by the beam. The conditions for injection into the tube necessary to realize the maximum current are calculated. The basic method used for the investigation is that of random search. The results can be used for choosing the working conditions of a tube, of the proton injector, and of the ion-optical matching system. Author (NSA)

N68-38883# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.
SOME NEW MEASUREMENTS AND RENORMALIZATIONS OF NEUTRON CAPTURE CROSS SECTION DATA IN THE KEV ENERGY RANGE
W. P. Poenitz, D. Kompe, H. O. Menlove, and K. H. Beckurts Oct. 1967 14 p Presented at the Intern. Atomic Energy Agency Symp. on Fast Reactor Phys. and Related Safety Problems, Karlsruhe, W. Germany, 3 Nov. 1967
(EUR-3679e; KFK-635; CONF-671043-9; EURFNR-404) CFSTI: HC $3.00/MF $0.65

The absolute neutron capture cross section of Au was measured for neutron energies of 25 to 500 keV to an accuracy of about ±5%. Absolute normalization of the relative cross section curve was performed at a neutron energy of 30 keV. The capture cross section of ^{238}U was measured over the same energy range. The capture cross sections, relative to Au, of a number of medium weight and heavy nuclides were measured, using a time of flight method and a large liquid scintillator tank, in the energy range from 10 to 150 keV. Evaluated data are presented for Cs, Hf, Mo, Nb, Re, Ta, and W. The implications of the new data for fast reactor calculations were studied. NSA

N68-38889# Oak Ridge National Lab., Tenn.
AN APPARATUS FOR MEASUREMENT OF ELECTRON ATTACHMENT AND ELECTRON SWARM DRIFT VELOCITIES AT HIGH TEMPERATURES
W. G. Hendrick (M.S. Thesis), L. G. Christophorou, and G. S. Hurst Feb. 1968 62 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1444) CFSTI: HC $3.00/MF $0.65

An apparatus built for the study of electron swarm drift velocities and electron attachment to molecules for temperatures ranging from 273° to 473°K was used for the study of electron attachment to SF_6 at thermal energies. The thermal rate of attachment to SF_6 was measured in the temperature range 273° to 473°K and found to be temperature-independent. Thus it is concluded that the electron-attachment cross section for SF_6 at thermal energies varies inversely with the electron velocity when the attachment cross section is assumed to be expressed in powers of the electron velocity. Electron drift velocities in nitrogen and ethylene were also measured over the temperature range 273° to 473°K and found to decrease as temperature increases. An analysis of the temperature dependence of the w data in C_2H_4 yielded a velocity-independent cross section for momentum transfer equal to $(4.37 \pm 0.26) \times 10^{-16}$ cm^2 at thermal energies. This finding was further used to obtain information on the scattering of thermal electrons from polar molecules. Author (NSA)

N68-38891# Academia R.P.R., Bucharest. Inst. De Fiz. Atomica.
ANGULAR CORRELATION MEASUREMENTS IN THE $B^{11}(p\pi\gamma)C^{11}$ REACTION FOR $E_p = 7.8$ MeV
A. Calboreanu, M. Molea, O. Salagean, A. Ciocanel, and I. Minzatu Jul. 1967 8 p refs
(IFA-CRD-35)

An experimental arrangement for measuring the $^{11}B(p,\pi'\gamma)$ ^{11}C reaction angular correlations is described. Some conclusions are also drawn concerning the reaction mechanism for this nuclear process. Author (NSA)

N68-38892# California Univ., Berkeley. Lawrence Radiation Lab.
DECAY PARAMETERS FOR POSITIVE NEGATIVE HYPERON YIELDS NEUTRON PLUS POSITIVE NEGATIVE PION
Roger O. Bangerter, Margaret Alston-Garnjost, Angela Barbaro-Galtieri, Lawrence K. Gershwin, Terry S. Mast et al 26 Aug. 1967 8 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967
(Contract W-7405-eng-48)
(UCRL-17781; CONF-670934-8) CFSTI: HC $3.00/MF $0.65

Measurements of the decay parameters β_+ and γ_+ for $\Sigma^+ \rightarrow n + \pi^+$ are presented. It is confirmed that the $\Sigma^+ \rightarrow n + \pi^+$ decay take place predominantly in the P wave, and found that $\Sigma^- \rightarrow n + \pi^-$ is dominated by S-wave decay, in agreement with the $\Delta I = 1/2$ rule. The experiment was performed at the Bevatron using the 25-inch hydrogen bubble chamber. More than 10^5 charged Σ hyperons produced by $K^- + p$ interactions at an average momentum of 385 MeV/c were analyzed. NSA

N68-38893# Illinois Univ., Urbana.
THE REACTION PROTON PROTON YIELDS PROTON PROTON POSITIVE PION NEGATIVE PION AT 7.9 GeV/c
Donald Frank Grether (Ph.D. Thesis) 1968 148 p refs
(Contract AT(11-1)-1195)
(COO-1195-125) CFSTI: HC $3.00/MF $0.65

The reaction $p\,p \rightarrow p\,p\,\pi^+\pi^-$ was studied at an incident momentum of 7.9 GeV/c using the 80-inch hydrogen bubble chamber. Approximately 3600 events of the reaction were identified; the cross section was determined to be 2.54 ± 0.13 mb. The reaction is found to be dominated by production of the quasi-three body final state $N^*{}^{++}\,p\,\pi^-$. A simple one pion exchange model is compared to the data and is shown to give generally good results for invariant mass distributions for the entire final state, and for mass and angular distributions for the quasi-three body state. Discrepancies between the data and the model are found to be primarily associated with enhancements in the $N^*{}^{++}\,\pi^-$ or $p\,\pi^+\pi^-$ mass distributions at about 1425 MeV and 1700 MeV. Examination of the 1425 MeV enhancement indicates an apparent interference process rather than an incoherent sum of one pion exchange background and resonance production; the enhancement could not be identified as the N*(1470), the P_{11} wave resonance of π^-p phase shift analysis. Author (NSA)

N68-36894# California Univ., Berkeley. Lawrence Radiation Lab.
COMMENTS ON THE DISCREPANCIES IN THE MEASUREMENTS OF ϵ IN POSITIVE KAON YIELDS NEUTRAL PION PLUS POSITIVE MUON PLUS NEUTRINO
R. F. Stiening May 1968 12 p refs Presented at Am. Phys. Soc. Meeting, Washington, 22-25 Apr. 1968
(Contract W-7405-eng-48)
(UCRL-18231; CONF-680439-2) CFSTI: HC $3.00/MF $0.65

The nature of the disagreement between the various experimental determinations of Ξ in $K^+ \rightarrow \pi^0 + \mu^+ + \nu$ decay is illustrated, and several explanations previously suggested for resolving it are discussed. Experimental references are confined to work on K^+ decay, although K^0 decay data also generally support the conclusions drawn. It is found that the reported discrepancies in determinations of Ξ must be attributed either to incorrect experimental data or to a violation of muon-electron weak universality. NSA

N68-36901# Birmingham Univ. (England).
PARTICLE PRODUCTION FROM COPPER AND URANIUM TARGETS BY 8 GEV/C PROTONS
J. D. Davies, A. A. Carter (Cambridge Univ.), and D. V. Bugg (Rutherford High Energy Lab.) 1967 23 p refs
(RPP/H-28) CFSTI: HC $3.00/MF $0.65

A detailed study was made of the production of K^- and π^- mesons at 690, 745, and 935 MeV/c by 8 GeV/c protons incident on copper and uranium targets. Yields are reported as a function of target length over the range of production angles 0° to 15°. The maximum yield for thick targets occurs at about 7°, and it is shown that this may be understood in terms of re-absorption of secondaries within the target. The ratios K^-/π^-, p/π^+, p/π^- were also measured within the momentum range 600 to 2600 MeV/c. Author (NSA)

N68-36911# California Univ., Berkeley. Lawrence Radiation Lab.
MOLECULAR-BEAM ELECTRIC-RESONANCE SPECTRA OF THE LITHIUM HYDRIDES
Elaine Rothstein 23 Feb. 1968 70 p refs
(Contract W-7405-ENG-48)
(UCRL-17948) CFSTI: HC $3.00/MF $0.65

Radio-frequency spectra were observed in the first rotational state of ^7LiH, ^7LiD, ^6LiH, and ^6LiD by the molecular-beam electric-resonance method. Analysis of the spectra made possible the determination of accurate dipole moments and nuclear-hyperfine interaction constants. The experimental values are compared to the available quantum mechanical calculations. The polarizable ion model is also compared to the experiment. Author (NSA)

N68-36927# Los Alamos Scientific Lab., N. Mex.
A RELATIVITY NOTEBOOK FOR MONTE CARLO PRACTICE
C. J. Everett 13 Feb. 1968 183 p
(Contract W-7405-eng-36)
(LA-3839) CFSTI: HC $3.00/MF $0.65

The basic ideas and formulas of special relativity are organized into a form convenient for Monte Carlo treatment of relativistic systems of point particles. The dynamics of a point particle, classes of systems, transmutations of systems, and cross sections are discussed. NSA

N68-36929# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
PERTURBATION THEORY OF MASSIVE YANG-MILLS FIELDS
M. Veltman Aug. 1968 22 p refs
(TH-68/28) CFSTI: HC $3.00/MF $0.65

Perturbation theory of massive Yang-Mills fields is investigated with the help of the Bell-Treiman transformation. Diagrams containing one closed loop are shown to be convergent if there are more than four external vector boson lines. The investigation presented does not exclude the possibility that the theory is renormalizable. Author

N68-36935# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
STUDIES ON THE RESIDUAL POLARIZATION OF NEGATIVE μ MESONS IN HYDROCARBONS [ISSLEDOVANIE OSTATOCHNOI POLYARIZATSII OTRITSATEL'NYKH MYU-MEZONOV V UGLEVODORODAKH]
V. S. Evseev, V. S. Roganov, V. A. Chernogorova, G. G. Myasishcheva, and Yu. V. Obukov 1968 4 p ref In RUSSIAN
(JINR-P14-3809)

In order to verify the effect of the chemical bond or structural features of condensed media on the residual polarization $P\mu$ by the spin precession method of μ^- mesons in a magnetic field, the asymmetry coefficient $a \approx P\mu$ in the angular distribution of μ^- decay electrons was measured for graphite and certain hydrocarbons, such as styrene, polyethylene, cyclohexane, paraffin, phenylcyclohexane, benzene, polystyrene, and toluene. The experiments involved measurement of the electron counts of μ^- decay as a function of time since the stoppage of the muon in the target. It was found that the a values of hydrocarbons were less than half of that of graphite. This may be due to the introduction of C into the chemical bond or to the change of the structure of the materials. It is of interest to note that the $P\mu$ value changes suddenly when going from the monomer to the polymer (styrene 3.68 ± 0.18; polystyrene 2.22 ± 0.27). NSA

N68-36944# Celmece Nuclear Research Center, Istanbul (Turkey).
LOCALIZATION PROPERTIES OF THE UNITARY REPRESENTATIONS OF THE POINCARE GROUP IN FIELD THEORY
Feza Guersey [1966] 17 p refs
(CNAEM-53)

Some properties of the unphysical representation of the Poincaré group are discussed. The main result is that the representations with spacelike momentum can be localized in time and two space directions. Explicit localization operators were constructed for this case. These operators are the analogs of the Newton-Wigner position operators. The existence of such operators allows the introduction of harmonic oscillator ladder operators that provide discrete infinite-dimensional representations of the Poincaré group. To use the unphysical representations in field theory where only physical states exist a covariant Heisenberg field operator is separated into parts irreducible under the Poincaré group by taking its matrix elements between two physical states or a physical state and the vacuum. Then the state can be chosen so that the matrix elements are associated with both the physical and the unphysical representations. NSA

N68-36946# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
ON THE RELATION BETWEEN CURRENTS AND S-MATRIX
R. Omnes Sep. 1968 6 p refs
(TH-68/29) CFSTI: HC $3.00/MF $0.65

The problem of the determination of currents and the off-mass-shell extension of scattering amplitudes is considered within the context of analytic S-matrix theory, keeping up to three particles inside the unitarity relations. The technique used is a straightforwatd application of the N/D formulation of the three-body problem. It is found that anomalous thresholds do not play any role in the problem and that two cases can be solved explicitly, namely:

(1) the extension off the mass shell of the scattering amplitude; and (2) the computation of a form factor which tends to zero asymptotically. Author

N68-36947# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RADIATION OF A PARTICLE ON THE ORBIT IN THE U(R) $\approx -(\alpha/r^2$ FIELD)
I. Lukach 1968 23 p refs In RUSSIAN
(JINR-P2-3848)

The helicity scattering in the classical scattering theory is considered in the case of the $U(r) = -(\alpha/r^2)$ potential. The spectrum of the bremsstrahlung is calculated in the long-wave approximation in the classical and quantum cases for a particle moving in this field. It is shown that in the scattering spectrum of such a particle a series of maxima appears, the number of which in the classical case is equal to the number of particle revolutions around the scattering center, while in the quantum case it is equal to the integral part of the difference of the scattering phases of initial and final states divided by π. Author (NSA)

N68-36948# Bettis Atomic Power Lab., Pittsburgh, Pa.
INTERFACE CONDITIONS FOR FEW GROUP EQUATIONS WITH FLUX-ADJOINT WEIGHTED CONSTANTS (LWBR DEVELOPMENT PROGRAM)
A. J. Buslik Jan. 1968 24 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-733) CFSTI: $3.00/MF $0.65

Few-group diffusion equations are derived from variational principles. It is shown that by a proper choice of trial functions it is possible to derive a few-group fluxes and currents are obtained, even when the few-group constants are obtained by flux-adjoint weighting. The analysis is facilitated by the use of functionals which incorporate the interface condition of flux continuity by means of Lagrange Multipliers. Two functionals are used, giving two variants of the theory. Both functionals have as Euler equations the P-1 approximation to the time-independent, eigenvalue form of the energy-dependent transport equation. In addition, the current and flux interface boundary conditions are part of the complement of Euler conditions of the functionals. Author (NSA)

N68-36949# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
METHODS OF SEPARATION OF NUCLEAR REACTION CHANNELS WHILE BOMBARDING THE BUBBLE CHAMBER WITH 2 TO 10 GeV NEUTRONS
V. I. Moroz, A. V. Nikitin, and Yu. A. Troyan 1968 12 p refs In RUSSIAN
(JINR-P1-3881)

The methods of separation of the reaction channels of the np-interactions in three- and five-prong stars, produced while bombarding a 24-litre bubble chamber with the 2- 10 GeV neutron beam, were considered. The separation is based on the χ^2 method and on the investigation of extreme kinematics using some considerations of the probability of realization of the effective masses of secondary particles. As a result, a sufficiently good separation of the reaction channels is achieved. The methods considered allow the most probable momentum of the neutron, which induced this interaction, to be estimated. Author (NSA)

N68-36960# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
A STUDY OF THE SPONTANEOUSLY FISSIONING ISOMER OF Am-242 THROUGH Am-241 (n,γ) REACTION
G. N. Flerov, A. A. Pleve, S. M. Polikanov, S. P. Tretyakova, I. Boca et al May 1967 9 p refs
(IFA-CRD-34)

The excitation function for the $^{241}Am(n,\gamma)^{242}Am$ reaction leading to the excitation of the 14-ms spontaneously fissioning isomer was studied using neutrons with energies in the range 0 to 6.5 MeV. The experimental results can be well explained taking into account the hypothesis of Strutinsky concerning the shape isomerism. Author (NSA)

N68-36986# Columbia Univ., New York.
CP NON-INVARIANCE, ELECTROMAGNETIC INTERACTION, AND FIELD-CURRENT IDENTITIES
T. D. Lee [1967] 27 p refs Presented at the Intern. Symp. on Electron and Photon Interactions at High Energies, Stanford, Calif., Sep. 1967 Sponsored by AEC
(NYO-1932(2)-127; CONF-670923-3) CFSTI: HC $3.00/MF $0.65

The possibility that the CP violation is due to the electromagnetic interaction is considered. The present status of CP noninvariance, implications of nonconservation, theoretical consequences of C_{st} H_{yst} $C^{-1} \neq H_{\gamma}$, and a summary of the experimental consequences are covered. The algebraic relations between K_{μ}, part of the hadronic electromagnetic current, and other observed currents are discussed. These are derived based on the general ideas of field-current identity. NSA

N68-36968 Technische Hochschule Hannover (West Germany).
THEORY OF INELASTIC SCATTERING OF NUCLEONS IN NONLINEAR NUCLEI [THEORIE DER INELASTISCHEN STREUUNG VON NUKLEONEN AN UNGERADEN KERNEN]
Kurt Emrich (Ph.D. Thesis) 1967 61 p refs In GERMAN
CFSTI: $3.00

The Green functions are used to develop an exact formula for the T matrix of inelastic nucleon scattering on nonlinear nuclei. Interchange effects as well as asymmetry are taken into account in this formula. The result contains the vertex Γ of a four-point Green function K (derived in this case from a Bethe-Salpeter equation) and residues of two-point Green functions G. If the residues of bound conditions are known in an appropriate form, the T matrix can be calculated from the formula when it can be assumed that the energy of the conditions in the intake and output channels is replaceable by an optical potential. In many instances it is also possible to determine the T matrix up to an angle-independent factor without knowing the residues. Transl. by K.W.

N68-36969 Technische Hochschule Hannover (West Germany).
TRANSITION PROBABILITY AND EXPECTED VALUES OF SINGLE PARTICLE OPERATORS IN NUCLEI ACCORDING TO THE GREEN FUNCTION METHOD [UEBERGANGSWAHRSCHEINLICHKEITEN UND ERWARTUNGSWERTE VON EINTEILCHENOPERATOREN IN KERNEN NACH DER METHODE DER GREENSCHEN FUNKTIONEN]
Werner Theis (Ph.D. Thesis) 1968 91 p refs In GERMAN
CFSTI: $3.00

Normal systems, i.e. systems in which pair interchange effects are negligible, are investigated by Green functions for transition probabilities and expected values of single particle operators in nuclei. The single-particle Green function is treated as a sum derived from non-dominant pole terms and dominant pole terms whose residues are all of comparable value. A simple model is used to estimate the residue distribution of the non-dominant poles. With strict observance of the retarded interaction Γ, a renormed interaction between particle and hole results which is still frequency dependent. The consequences of calibration variance relations are not considered, but alternate possibilities for parameter reduction are given. Transl. by K.W.

N68-36976# Texas A&M Univ., College Station.
RESEARCH AND OPERATION OF THE TEXAS A AND M VARIABLE ENERGY CYCLOTRON
1 Jul. 1968 28 p ref
(Contract AT(40-1)-3398)
(ORO-3398-12) CFSTI: HC $3.00/MF $0.65

The analysis of high-resolution γ-ray and conversion-electron spectra in the decay of 15-hour ^{188}Ir continued; multipolarities were assigned to 145 transitions among 40 levels proposed for ^{188}Os. In addition to the well-established ground-state and K = 2 rotational bands, a second K = 0 rotational band is proposed with the bandhead at 1530 keV. Preliminary investigations of systems for studying nucleon interactions in three-body configurations were performed. Research programs dealing with nucleon–nucleon scattering, (^{3}He,d) and (d,^{3}He) reactions, Co sources, heavy ion penetration, angular momentum effects in nuclear reactions, fission fragments, activation analysis, and radiotherapy are also outlined. The cyclotron development program is summarized. NSA

N68-36987# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
STUDY OF GAMMA EMISSION FROM PLUTONIUM [ETUDE DE L'EMISSION GAMMA DU PLUTONIUM]
Jean-Yves Guezenec and Jean Paul Noel May 1968 26 p refs In FRENCH; ENGLISH summary
(CEA-R-3547) CFSTI: HC $3.00/MF $0.65

In order to study the problems arising from the handling of plutonium fuel, it is necessary to know exactly the gamma emission spectra of each isotope present. The available literature shows anomalies, more particularly in the case of plutonium-240 emission. A table is given of the main X and γ emission of plutonium isotopes which may be used for dose calculations. The figures given come both from a literature survey and from experimental research. A spectrometry has been carried out on a plutonium sample. Author (ESRO)

N68-36989# International Centre for Theoretical Physics, Trieste (Italy).
IMPROVED INVERSE GAP EQUATION PROCEDURE FOR THE QUASIPARTICLE CALCULATIONS
Y. K. Gambhir May 1968 42 p refs Submitted for publication
(IC-68-32) CFSTI: HC $3.00/MF $0.65

An improvement in the inverse gap equation (IGE) method is proposed in which the fed single-quasiparticle energies are corrected either by the second-order perturbation theory or by the modified Tamm-Dancoff approximation (MTDA) theory at each iteration. The procedure is fast converging. The behavior of the extracted quantities for odd Ni-isotopes is reasonably close to their expected theoretical behavior. The extracted Hartree-Fock (HF) energies are highly sensitive to the choice of the effective two-body interaction. These quantities are used in calculating the various quasiparticle quantities for the corresponding even Ni-isotopes through the BCS or pairing model equations. Quasiparticle configuration-mixing calculations are made for both odd and even Ni-isotopes using their respective sets of quasiparticle quantities obtained by the conventional BCS, IGE and the improved IGE procedures. These sets of quasiparticle results are compared and their relative merits discussed. Author (ESRO)

N68-36990# International Centre for Theoretical Physics, Trieste (Italy).
ON SPECTRAL FUNCTIONS SUM RULES
C. G. Bollini and J. J. Giambiagi Jul. 1968 12 p refs Submitted for publication
(IC-68-61) CFSTI: HC $3.00/MF $0.65

Sum rules for the spectral functions of vector and axial fields are obtained from hypotheses on the behavior of vacuum values of the commutators on the cone. The consequences of vector dominance are examined. A discussion is given on the relation between our hypothesis and that of the equality of the unrenormalized masses and coupling constants. The sources of the fields are taken to be the weak vector and axial vector currents. Author (ESRO)

N68-36994# Gulf General Atomic, San Diego, Calif.
NEUTRON CROSS SECTIONS FOR U^{234} AND U^{236}
M. K. Drake and P. F. Nichols 1 Sep. 1967 76 p refs
(Contract AT(04-3)-167)
(GA-8135) CFSTI: HC $3.00/MF $0.65

A survey was made of the available experimental cross-section measurements for ^{234}U and ^{236}U. Sets of recommended neutron cross sections are presented for neutron energies from 0.001 eV to 15 MeV. Resonance parameters are also included. NSA

N68-36995# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON A POSSIBLE DECUPLET OF BARYON RESONANCES $5/2^+$ [O VOZMOZHNOM DEKUPLETE BARIONNYKH REZONANSOV $5/2^+$]
F. Gere and L. Enkovski 1968 6 p refs In RUSSIAN
(JINR-P2-3820)

A possible decuplet of baryon resonances $5/2+$ is investigated: decay rates of processes of the type $5/2+ \rightarrow 1/2+ + 0-$ are calculated, comparison with experiment is carried out. Author (NSA)

N68-36996# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
REPRESENTATIONS OF THE CANONICAL (ANTI) COMMUTATION RELATIONS IN INFINITE TENSOR-PRODUCT SPACE
N. V. Sushko and O. I. Zavialov 1968 29 p refs
(JINR-E2-3831)

A necessary and sufficient condition that a representation of the canonical (anti) commutation relations is unitary equivalent to a direct product representation in von Neumann incomplete tensor-product space is derived as well as a necessary and sufficient condition for unitary equivalence of any two direct-product representations. A characterization of all direct-product representations is given in terms of quasi-invariant product-measures. Given a direct-product representation, the corresponding measure is evaluated explicitly. An immediate consequence of these theorems is a necessary and sufficient condition for equivalence of quasi-invariant product-measures. Special classes of canonical transformations are discussed. Author (NSA)

N68-37000# Purdue Univ., Lafayette, Ind.
HIGH ENERGY PHYSICS Annual Progress Report, Jun. 1, 1967–May 31, 1968
Masao Sugawara 1968 27 p refs
(Contract AF(11-1)-1428)
(COO-1428-64) CFSTI: HC $3.00/MF $0.65

Theoretical research on high-energy physics at Purdue University is summarized. This research includes interactions, resonance production, symmetry groups, decays, coupling constants, dispersion relations, the quark model, and Regge pole theory. NSA

N68-37001# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
LOCALIZATION OF ALPHA EMITTERS BY DAMAGE PRODUCTION IN A THIN FILM. APPLICATION TO THE STUDY OF ALPHA EMITTER DIFFUSION IN IRRADIATED SAMPLES
Brigitte Houdaille and Michel Perrot Mar. 1968 25 p In FRENCH; ENGLISH summary
(CEA-R-3426)

The process of recording α particles on cellulose nitrate films, called alphagraphy, is applied to the study of the diffusion of α-emitting elements in irradiated alloys. The existence of diffusion is shown by attacking the film with concentrated caustic soda after exposure. The insensitivity of the recorder by $\beta\gamma$ radiation emitted by the sample after passing in the reactor makes it possible to operate with long exposure times and to detect small diffusions. The concentration-penetration curves are drawn up after carrying out a densitometric analysis of the alphagraphs. As the cellulose nitrate is affected only by α particles of energies of between 0.5 and 4 MeV, it was first necessary to determine the yield of the recorder for α particles emitted by a thick source, i.e., whose energy varies between 0 and E_0, E_0 being the energy of the alpha emitter. The concentration C of the α-emitter, as a function of the optical density D of the alphagraphy, and of the exposure time t is given by a simple relationship: $C = (D/at)$, where a is an experiment constant determined by calibration. It depends on the nature of the cellulose nitrate, of the α-emitting element and of the alloy studied.
Author (NSA)

N68-37002# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EFFECT OF THE NUCLEUS DEFORMATION ON THE NEUTRON RESONANCE DENSITY IN THE RARE-EARTH REGION
V. I. Furman and A. B. Popov 1968 16 p refs In RUSSIAN; ENGLISH summary
(JINR-P4-3925)

The existence of a maximum in the dependence of a level density parameter from the A atomic weight at $A \approx 150$ is pointed out. It is shown that the presence of this maximum can be explained by the scheme of one-particle states of deformed nuclei.
Author (NSA)

N68-37003# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PROBABILITIES OF THE Eλ TRANSITIONS AND PERMITTED β-DECAY IN THE ODD-MASS NUCLEI
F. A. Greev, S. P. Ivanova, and M. I. Chernei 1968 13 p refs In RUSSIAN; ENGLISH summary
(JINR-P4-3935)

The Eλ transitions and the allowed β decay in the odd-mass rare-earth nuclei were considered. The single-particle wave functions of the Woods-Saxon's potential were used in calculations. The values of the above probabilities, which agree well with the experimental results, were obtained, while the Nilsson's model predicts that the account of the effect of the pairing on the probability of the E1 transitions with $K = 0$ leads to worse agreement with the experimental data.
Author (NSA)

N68-37013# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
SINGULARITIES OF QUADRANGLE GRAPHS WITH THE RESONANCES IN AN INTERMEDIATE STATE [OSOBENNOSTI CHETYREKHUGOL'NYKH DIAGRAMM, SODERZHASHCHIKH REZONANSY V PROMEZHUTOCHNOM SOSTOYANII]
V. V. Anisovich 1967 17 p refs In RUSSIAN
(IFVE-STF-67-16-k)

The analytical properties of the quadrangle graph with two resonances in an intermediate state are considered. It is shown that this graph has a root singularity in the denominator which is close to the physical region of the reaction at $W \geq 2I$ (W is the total energy of the system, I is the resonance mass). The simple kinematic rule to find the position of this singularity is carried out.
Author (NSA)

N68-37017# Los Alamos Scientific Lab., N. Mex.
RADIATIVE CAPTURE OF FAST NEUTRONS
A. I. Abramov, A. A. Van'kov, V. N. Kononov, A. V. Malyshev, Yu. Ya. Stavisskii et al May 1968 14 p refs Transl. into ENGLISH from a Gos. Kom. po Ispol'z. At. Energ. SSSR, Obninsk Rept.
(LA-tr-68-18) CFSTI: HC$3.00/MF$0.65

A research program on the radiative capture of fast neutrons is briefly discussed, including absolute measurements in spherical geometry, detection of capture gamma rays, activation measurements, and theoretical calculations of cross sections.
NSA

N68-37018# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ATTEMPT TO OBSERVE α-DECAY OF Ku-260
E. D. Donets and V. A. Shchegolev 1968 14 p refs In RUSSIAN
(JINR-P7-3835)

Experiments on the search for the α decay of the ^{260}Ku isotope are described. The reaction ^{242}Pu(^{22}Ne,4n)^{260}Ku was used to synthesize ^{260}Ku. This isotope was identified by the method of registration of the α decay on daughter products. The experimental results give an upper limit of the cross section of about 2×10^{-34} cm^2. $\sigma(E)$ is given for the reaction ^{242}Pu(^{22}Ne,σ4n)^{260}102.
Author (NSA)

N68-37020 Tulane Univ., New Orleans, La.
DECAYS OF ODD PARITY BARYON RESONANCES
J. C. Carter (Loyola Univ., New Orleans, La.) and M. E. M. Head 30 Sep. 1968 14 p refs
(Grant NSF GP-5590)

Baryon members of the three quark SU(6) 70 and 56 are coupled with a vector spurion assigned to the 1^3 of an SU(6) 35 to form odd parity baryon resonances. Branching ratios for decays are calculated using the relativistic techniques of SU(6)$_W$ and are compared with experiment. The $N_{1/2}^*(1518)$ and $Y_1^*(1660)$ are assigned to an $8^4 \subset {}_1{}^3 \otimes 8^2$ of $35 \otimes 70$. Observed branching ratios indicate that the decays proceed through the 70 channel as predicted. The $Y_1^*(1765)$, $Y_0^*(1830)$, and $\xi_{1/2}^*(1935)$ are assigned to an $8^6 \subset 1^3 \otimes 8^4$ of $35 \otimes 70$. Missing members of these multiplets are discussed and branching ratios given. Decay amplitudes for other possible multiplets are stated.
Author

N68-37021# Rochester Univ., N. Y. Nuclear Structure Research Lab.
A STUDY OF THE Si 28 (d, He 3) Al 27 REACTION
H. E. Gove, K. H. Purser, J. J. Schwartz, W. P. Alford, and D. Cline May 1968 49 p refs Supported by NSF
(UR-NSRL-5)

Spectroscopic factors have been measured for all the levels in ^{27}Al up to 3 MeV from the reaction ^{28}Si(d,^{3}He)^{27}Al. The level at 3.00 MeV with $J\pi = 9/2+$ is excited much more strongly than that at 2.98 MeV with $J\pi = 3/2+$ although it does not show either an $l=2$ or an $l=4$ pick-up distribution. The results are not in agreement with the collective rotational model. Agreement is found with the weak coupling core excitation model. Occupation numbers are obtained for protons in $d_{5/2}$, $d_{3/2}$, and $s_{1/2}$ orbits for the ground state wave function of ^{28}Si. These are compared with the neutron occupation numbers.
Author

N68-37027# International Centre for Theoretical Physics, Trieste (Italy).
REGGE TRAJECTORIES AND RESIDUES IN THE QUARK MODEL
E. J. Squires May 1968 23 p refs Submitted for publication
(IC-68-36) CFSTI: HC $3.00/MF $0.65

A relativistic quark model of mesons is considered. It is shown that the slopes and positions of Regge trajectories imply curious constraints on the input forces of the N/D method. One of two possible general forms for these constraints gives a natural explanation of the linearity of trajectories over a large range of s, but leads to residues which vary too rapidly with energy to accord with experimental data. For the Pomeranchon, however, an approximately constant residue appears most natural - again in violation of experimental evidence. If the model has any relevance to physics it therefore supports the idea that high-energy elastic scattering is not dominated simply by a Regge pole. Author (ESRO)

N68-37028# International Centre for Theoretical Physics, Trieste (Italy).
ANALYSIS OF KN TOTAL CROSS-SECTIONS WITH CONTINUOUS MOMENT SUM RULES
C. Ferro Fontán, M. Lusignoli (Rome Univ.), R. Odorico (Trieste Univ.), M. Restignoli (Rome Univ.), and G. Violini (Rome Univ.) Jul. 1968 8 p refs Sponsored in part by Ist. Nazl. di Fis. Nucl. Submitted for publication
(Contract F61052-67-C-0084)
(IC-68-66) CFSTI: HC $3.00/MF $0.65

Using continuous moment sum rules for KN scattering it is found that $\alpha_\rho(0) = 1 \pm 0.02$ and that ω is the only $T^G = 0^-$ relevant pole ($\alpha_\omega(0) = 0.48$). An uncertainty ≈ 0.3 appears to affect the determination of $\alpha_\rho(0)$ and $\alpha_{A_2}(0)$ because of experimental errors. Author (ESRO)

N68-37029# International Centre for Theoretical Physics, Trieste (Italy).
SUCCESS AND LIMITATIONS OF TWO- AND FOUR-QUASIPARTICLE TAMM-DANCOFF THEORIES OF VIBRATIONAL STATES. APPLICATIONS TO EVEN TIN ISOTOPES WITH A REALISTIC NUCLEON-NUCLEON POTENTIAL
M. Gmitro, A. Rimini (Trieste Univ.), J. Sawicki (Trieste Univ.), and T. Weber May 1968 25 p refs Sponsored in part by Ist. Nazl. di Fis. Nucl. Submitted for publication
(IC-68-29) CFSTI: HC $3.00/MF $0.65

Extensive calculations are performed of the spectra of the even Sn isotopes with the two- and four-quasiparticle (qp) Tamm-Dancoff theories. The effective nuclear forces are the Tabakin and the Yale-Shakin potentials renormalized for core polarization involving up to all the subshells between the magic numbers 8 and 126. Several different sets of single-particle energies are considered, one of which corresponds to a Woods-Saxon potential. An overall semi-quantitative agreement with the data is obtained. We show how relatively large values of the quadrupole moment of the 2_1^+ state (such as $Q(2_1^+) \simeq +0.125$ barn) may arise from large two-qp-four-qp cross-terms even in cases where four-qp components are small. Many aspects of the theory are critically examined; in particular, several different approximations in projecting out spurious sets of the nucleon number non-conservation. Projected improvements and developments of the theory are outlined. Author (ESRO)

N68-37030# International Centre for Theoretical Physics, Trieste (Italy).
EFFECTIVE NUCLEAR FORCE OF A REALISTIC POTENTIAL. A SELFCONSISTENT APPROACH
M. Gmitro Jun. 1968 10 p refs Sponsored by UNESCO Submitted for publication
(IC-68-52) CFSTI: HC $3.00/MF $0.65

Core polarization corrections to the Tabakin realistic nucleon-nucleon potential have been calculated by a selfconsistent method. The derived residual interaction is demonstrated by the example of the tin isotope spectroscopy. Author (ESRO)

N68-37041# Purdue Univ., Lafayette, Ind.
OBSERVATION OF AN I=0 $\mu^-\mu^+$ RESONANCE AT A MASS OF 1.05 GeV
D. H. Miller, L. J. Gutay, P. B. Johnson (Notre Dame Univ.), P. Kenney, (Notre Dame Univ.), and Z. Guiragussion (Stanford Univ.) Jul. 1968 9 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-84; CONF-680809-5) CFSTI: HC $3.00/MF $0.65

An I=0 enhancement at 1.050 ± 0.01 GeV was observed in the $\pi^-\pi^+$ final state in 7916 events belonging to the reaction $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ at an average incident beam momentum of 4.0 GeV/c. This enhancement is produced primarily at a four momentum transfer of less than 0.1 GeV^2 and observed most clearly in the region $\cos\theta < -0.75$, where θ is the angle between the outgoing and incident π^- in the dipion rest system. The decay angular distribution is best fitted by a D wave, and this enhancement appears to be incompatible with the S^* previously observed in the KK final state. NSA

N68-37042# Case Western Reserve Univ., Cleveland, Ohio.
HIGH MOMENTUM TRANSFER STUDIES OF $\pi^- p \rightarrow \pi^0 N$ TO BE PERFORMED AT THE ZERO GRADIENT SYNCHROTRON, ARGONNE NATIONAL LABORATORY
8 May 1968 21 p refs
(Contract AT(11-1)-1749)
(COO-1749-2) CFSTI: HC $3.00/MF $0.65

Experiments are proposed for the study of the reactions $\pi^- + p \rightarrow \pi^0 + n$ and $\Pi^- + p \rightarrow \eta^0 + n$ at 3.0 to 6.0 GeV/c at a t of 1.5 to 6.0 $(GeV/c)^2$. The experimental arrangement using spark chambers, the expected event rate, and the background arising from $\pi^- + p \rightarrow \pi^0 + \pi^0 + n$ are discussed. Also the compatibility of studying the reactions $K^- + p \rightarrow K^0 + n$ and $\pi^- + p \rightarrow \Lambda^0(\Sigma^0) + K^0$ is considered to determine whether useful information can be obtained during the same run without jeopardizing the main measurement. NSA

N68-37047# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
FAST RADIOCHEMICAL SEPARATIONS BASED ON THE SZILARD-CHALMERS-EFFECT IN LANTHANIDE COMPLEXES WITH POLYAMINEPOLYCARBOXYLIC ACIDS. 2:COMPLEXES OF THE LANTHANIDES WITH DIETHYLENETRIAMINEPENTAACETIC ACID AS TARGETS TO BE EXPOSED WITH 680 MeV PROTONS
G. Yu. Baier, V. A. Khalkin, Kh. Grosse-Ryuken, and G. Pfrepper 1968 12 p refs In RUSSIAN
(JINR-P12-3887)

Complexes of lanthanides with diethylenetriaminepentaacetic acid (DTPA) are proposed to be exposed to high-energy protons in order to reduce the time for preparation of neutron-deficient radioactive isotopes of the rare earths. The larger fraction of nuclear reaction products was in the form of ions due to the Szilard-Chalmers effect and easily separated from target material. These chelated compounds as targets in combination with selective chromatography make it possible to measure the gamma spectra of many radioactive isotopes with $T_{1/2} < 30$ min. Author (NSA)

N68-37048# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, 1-30 Jun. 1968
29 Jul. 1968 136 p refs
(Contract W-31-109-ENG-38)
(ANL-7460) CFSTI: HC$3.00/MF$0.65

Highlights of project activities are summarized for the month of June 1968. For detailed summaries, see the annual reports from the following ANL divisions: Chemical Engineering, Metallurgy, Reactor Engineering, and Reactor Physics. During June the EBR-II was operated for 659 MWdt in a run with a full complement of fueled experimental subassemblies and a reference run with reflector subassemblies of stainless steel rather than depleted uranium. Nearly normal production was resumed in the Fuel Cycle Facility hot line. Experiments continued with the ZPR-3 Assembly 52, the second core of the FTR Phase-B critical program. Installation of the ZPPR reactor assembly and associated equipment was completed, and seal door and containment structure testing is in progress. Nuclear safety studies, including TREAT operations, and chemical separations activities are discussed. NSA

N68-37049# California Univ., Davis. Crocker Nuclear Lab.
HILBERT SPACE PROPERTIES OF THE INTERACTION REGION MODEL
J. V. Corbett 1 Apr. 1968 18 p ref
(Contract AT(11-1)-GEN-10)
(UCD-CNL-95) CFSTI: HC$3.00/MF$0.65

The interaction region model is discussed as a problem in the theory of linear transformations. The Hamiltonian for this model is shown to be a self-adjoint operator under certain, physically reasonable, conditions on the boundary data. The Hilbert space extensions of the domains of this self-adjoint operator and of the self-adjoint Hamiltonian operator for the potential model are proven to be isomorphic. Author (NSA)

N68-37050# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ANALYSIS OF THE REACTION Am 241(n,γ)Am 242mf [ANALIZ REAKTSII Am 241(n,γ)Am 242mf]
Kh. Yungklaussen and A. A. Pleve 1967 12 p refs In RUSSIAN
(JINR-P-15-3618)

An attempt is made to explain experimentally obtained excitation functions of the radiative capture of fast neutrons by the ^{241}Am nucleus, which leads to the production of spontaneously fissionable ^{242mf}Am isomer. It is assumed that the dependence of the potential energy on the value of β deformation has two maxima; the isomeric state is in the second potential well between two maxima. The calculated excitation function agrees well with the experimental one, if the second maximum is considered to be somewhat lower than the first maximum. Author (NSA)

N68-37068* Union Carbide Nuclear Co., Oak Ridge, Tenn.
SEGO: A COMPUTER CODE FOR UNFOLDING EXPERIMENTAL PULSE-HEIGHT DISTRIBUTIONS
W. R. Burrus and M. H. Young 3 Jul. 1968 60 p refs
(NASA Order R-104(1))
(NASA-CR-97254; ORNL-TM-2172) CFSTI: HC $3.00/MF $0.65
CSCL 18K

A mathematical procedure is described for unfolding scintillation pulse height spectra to obtain an estimate of the incident energy spectra. Two methods were developed, both giving equivalent numerical answers. The first method, known as Low Speed Sego, reduces the number of arithmetic operations for an N channel spectrum from the order of N^3 for conventional matrix inversion methods to the order of N^2 and simplifies the problem of constructing a model for the response of the spectrometer. The second method, known as High Speed Sego, further reduces the number of arithmetic operations to the order of 10N instead of N^2. High Speed Sego makes use of the same ideas as Low Speed Sego and, in addition, transforms the response matrix of the spectrometer in such a way as to produce a large number of zero elements. This transformation is only applicable if the "Hyodo" response function can be represented by straight line segments plus peaks (or by parabolic segments in a version under development known as Double High Speed Sego). Author

N68-37069# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUCLEON TRANSFER REACTIONS IN D.W.B.A. [LES REACTIONS DE TRANSFERT D'UN NUCLEON DANS LA D.W.B.A.]
Bertrand Giraud and Jean Picard Aug 1968 54 p refs In FRENCH; ENGLISH summary
(CEA-R-3574) CFSTI: HC$3.00/MF$0.65

The DWBA for one nucleon transfer reaction is described as simply and completely as possible to show the possibilities and limits of this method. The extraction of spectroscopic factors is also shown. Author (ESRO)

N68-37071# Junta de Energia Nuclear, Madrid (Spain).
STUDY OF SOME TECHNICAL PROBLEMS IN NUCLEAR EMULSIONS [ESTUDIO DE ALGUNOS PROBLEMAS TECNICOS EN EMULSIONES FOTONUCLEARES]
M. Pilar Tarrega Tornero (Ph.D. Thesis--Valencia Univ.) 1967 28 p refs In SPANISH; ENGLISH summary
(JEN-194-IFIC/I-58) CFSTI: HC$3.00/MF$0.65

A methodological study of various technical aspects of photographic emulsions is presented. This study enables the emulsion method to be used in certain physical problems, and can be summarized under the following headings. 1) Variation of different ionization indices with the degree of development. A measure of the degree of development is introduced. This measure called the 'α -mark', is based on the average width of tracks due to α -particles. Using the 'α -mark' the influence of several factors such as the duration, temperature and concentration of the developing liquid are investigated. A comparative study of the sensitivity of Ilford C2 and K2 emulsions is given. 2) Fading of tracks in the emulsion. The 'α -mark' is used to study the influence of temperature and humidity on the speed of fading. 3) Discrimination of high-energy particles by ionization measurements: by measuring the momentum p and the relative ionization g^* of very energetic particles, the effect of the developing liquid with depth in emulsion is studied. The percentage of analyzed particles which can be identified by the p-g^* method is given. 4) Distortion: a stack of Ilford K5 emulsion of pellicles thickness 600 μ m was exposed to a beam of 800 MeV pions produced in the CERN proton synchrocyclotron. In an attempt to reduce distortion, part of the stack was treated with 'colofon-resin'. The results of different methods of development on the distortion of resin-treated emulsions are given. Author (ESRO)

N68-37077# Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica.
HEAVY HYPERFRAGMENTS PRODUCED BY 800 MEV/C KAON IN NUCLEAR EMULSIONS [HIPERFRAGMENTOS PESADOS PRODUCIDOS POR K DE 800 MEV/C EN EMULSIONES NUCLEARES]
Marcial P. Doporto Laguia (Ph.D. Thesis--Valencia Univ.) 1967 25 p refs In SPANISH; ENGLISH summary
(JEN-193-DF/I-57) CFSTI: HC$3.00/MF$0.65

A statistical and phenomenological survey of nearly 1200 heavy hyperfragments produced by interaction of 800 MeV/c K^- with the heavy nuclei of Ilford K5 emulsion is presented. The emulsion was exposed in Berkeley. The variation of a long list of

parameters dealing with both the production and disintegration of the hyperfragments, with the size of the primary interaction is given. The results can be divided into those dealing with the production and the disintegration of the hyperfragments. It is shown that the present day Monte Carlo procedure does not reproduce the production characteristics with any great fidelity. It is thought that this is due to lack of detail in the input parameters. An asymmetry in the angular distribution of the disintegration products of the hyperfragments is confirmed by measurements in two other stacks, one irradiated with stopping K^- and the other with 6 GeV/c K^-. It is shown that this asymmetry can be explained if the lifetime of the heavy hyperfragment is of the order of 10^{-11} seconds. This last result implies that the lifetime of the unbound Λ^0 particle is reduced by a factor of 20 when it is bound to heavy nuclear matter. Author (ESRO)

N68-37079# Commissariat a l'Energie Atomique, Limeil (France).
STUDY OF THE REACTIONS ^{9}Be (d,α_0)^{7}Li, ^{9}Be (d,α_1)^{7}Li*, ^{9}Be (dt)^{8}Be AND ^{9}Be (dp$_0$)^{10}Be FROM 300 TO 1000 keV
Francoise Bertrand, Gerard Grenier, and Jacqueline Pornet May 1968 31 p refs In FRENCH; ENGLISH summary
(CEA-R-3504) CFSTI: HC $3.00/MF $0.65

The excitation curves, the angular distributions and the total cross-sections for the following reactions: ^{9}Be (d α_0)^{7}Li, ^{9}Be (d α_1)^{7}Li*, ^{9}Be (d, t)^{8}Be and ^{9}Be (dp$_0$)^{10}Be are presented in the energy range from 300 keV to 1 MeV. The results are in good agreement with the few studies already carried out. In order to present the results in absolute values they are normalized with those of Biggerstaff. Author (ESRO)

N68-37083# Brown Univ., Providence, R. I. Dept. of Physics.
PARTIAL-WAVE SCATTERING AMPLITUDE: ZEROS, SUBTRACTIONS, AND THE SIGN OF SCATTERING LENGTHS
Kyungsik Kang Sep. 1967 22 p refs
(Contract AT(30-1)-2262)
(NYO-2262TA-163) CFSTI: HC $3.00/MF $0.65

In the discussion of the partial wave scattering amplitude only the general requirements such as analyticity, unitarity, temperedness, and normal threshold behavior are assumed. The approach used reflects the powerfulness and usefulness of Herglotz functions in dispersion theory. Not only can the zeros of the amplitude be specified but also both high- and low-energy behaviors can be judged. NSA

N68-37089# International Centre for Theoretical Physics, Trieste (Italy).
ONE-NEUTRON TRANSFER REACTIONS IN EVEN AND ODD TIN ISOTOPES AND A REALISTIC NUCLEON-NUCLEON POTENTIAL
R. Alzetta (Trieste Univ.) and J. Sawicki May 1968 31 p refs Submitted for publication Sponsored by I.N.F.N.
(IC-68-33) CFSTI: HC $3.00/MF $0.65

Low-lying energy levels and wave functions of the even and odd isotopes of tin (A = 116–121) are calculated with 0.2 and 4 and 1 and 3 quasiparticle Tamm-Dancoff theories with the realistic two-nucleon potential of Tabakin renormalized for core polarization by Gmitro et al. All the spectra are in good over-all agreement with experiment. The corresponding spectroscopic factors for the one-neutron stripping and pick-up reactions are calculated and found to be in reasonable general agreement with the data of Schneid et al. and of Yagi et al. No adjustable parameters are involved in the theory (the single-particle input parameters are those of Brando). Author (ESRO)

N68-37101# Bonn Univ. (West Germany). Inst. fuer Strahlen und Kernphysik.
NUCLEAR STRUCTURE STUDIES BY (t,α) REACTIONS [KERNSTRUKTURUNTERSUCHUNGEN MIT (t,α) REAKTIONEN]
J. Bachner 1 Jun. 1967 44 p refs In GERMAN
(BMwF-FBK-67-75)

The reactions ^{64}Zn(t,α)^{63}Cu, ^{66}Zn(t,α)^{65}Cu and ^{50}Cr(t,α)^{49}V were measured at an incident energy of 13 MeV; in addition, the reaction ^{48}Ti(^{3}He,d)^{49}V was studied at an incident energy of 18 MeV. Excitation energies are given for the resolved levels and angular momenta; and spectroscopic factors, extracted from the DWBA analysis of the angular distribution, were determined. The ground state configurations of the target nuclei and the level structure of the final nuclei are discussed; some evidence was found for collective excitation in the (t,α) reaction. Author (NSA)

N68-37103# Westinghouse Electric Corp., Pittsburgh, Pa. Bettis Atomic Power Lab.
VARIATIONAL CALCULATION OF COMPLEX NATURAL MODES OF XENON OSCILLATION (LWB-LSBR DEVELOPMENT PROGRAM)
A. J. Buslik and W. A. Weinreich Sep. 1967 14 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-673) CFSTI: HC $3.00/MF $0.65

A variational calculation of the complex natural modes of Xe oscillation (p-modes) is presented. The I and Xe components of the p-modes are eliminated before the functional is set up, eliminating the need for trial functions for these variables. The eigenvalues p are determined by the solution of a polynomial equation. When used in conjunction with a single μ-mode trial function, an improvement in the usual μ-mode formalism is produced, since fast fission production of Xe can be taken into account more exactly. Author (NSA)

N68-37104# Paris Univ. (France).
REVIEWS OF THE RELATIVISTIC ASPECTS OF THE THREE-BODY PROBLEM: PRACTICAL COMPUTATIONS FORM FACTORS IN S-MATRIX THEORY
R. Omnes and J. L. Basdevant Mar. 1968 35 p refs Presented at the Intern. Conf. on the Three-Body Probl., Houston, Tex.
(LPTHE-TH-68/10; CONF-680442-1)

A review of the practical approaches to relativistic three-body calculations is given. Some attention is given to the limitations of the relativistic versions of the Faddeev equation and the separable approximation. The praatical results obtained with the three-pion system by Basdevant and Kreps are discussed and compared with the experimental data. The ND^{-1} approach to the three-body problem by Mandelstam is reviewed. For illustration and simplicity, the problem of the computation of form factors is given as an example. It is stated, and this is a new result, that the equations are self-contained. This implies that the Frazer-Fulco analysis of isovector form factors can be extended to the isoscalar form factors. Finally one gives the results of a recent extension of the same technique to the N-body problem. The conclusions are negative: linear equations in one variable for form factors do not seem to exist. Some consequences are derived which bear upon the existence, unicity and asymptotic behavior of current form factors. Author (NSA)

N68-37112# International Centre for Theoretical Physics, Trieste (Italy).
HARTREE–FOCK CALCULATIONS FOR LIGHT NUCLEI: LECTURE NOTES
M. Bouten May 1968 51 p refs
(IC-68-30) CFSTI: HC $3.00/MF $0.65

In the nuclear shell model theory the nucleon is assumed to be independent in a potential well. This well is chosen in a fairly independent way and parameters are adjusted to fit experimental data. In a better theory, one should show from the nuclear Hamiltonian and compute the shell-model potential from it. A solution is given for the HF equation taking into account the symmetry restriction and results are applied to light nuclei: ^{8}Be, ^{12}C and ^{20}Ne. HF calculations also applied to solve the problem of collective moments and transitions. ESRO

N68-37121# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ENERGY ESTIMATION IN COLLISIONS OF VERY HIGH ENERGY PIONS WITH NUCLEI OF PHOTOGRAPHIC EMULSION

J. Gierula and S. Krzywdzinski 1967 12 p refs

(INR-828/VI/PH)

On the basis of about 500 interactions of particles with energy of few hundred GeV with nuclei of photographic emulsion a systematic dependence of the median emission angle of secondary particles on the number of evaporation prongs was found. In consequence the corrections to the energy estimates calculated by the Castagnoli method were obtained. Author (NSA)

N68-37123# International Centre for Theoretical Physics, Trieste (Italy).

THE K_{l4} FORM FACTORS IN CURRENT ALGEBRA WITH HARD PIONS AND KAON

A. Q. Sarker (Islamabad Univ.) Jul. 1968 43 p refs Submitted for publication

(IC-68-58) CFSTI: HC $3.00/MF $0.65

The axial form factors in K_{l4} decays are calculated using the technique of current algebra, hard kaon and pions, the assumption of PCAC and the spectral function sum rules. The assumption of meson-dominance of certain vertex functions and inverse propagators as given by Schnitzer and Weinberg is inherent in such calculations. Taking the ξ-parameter from the experimental K_{l3} decays and using the predicted axial form factors at their zero arguments, the decay rates for $K^{+}\to\pi^{+}\pi^{-}e^{+}\nu$ and $K^{+}\to\pi^{+}\pi^{-}\mu^{+}\nu$ are then calculated. On comparison with their recent observed rates, it is found that the value $\xi_{bf}=0.6$ is strongly favoured as opposed to $\xi_{pol}=-1.0$. The values of the form factors for other K_{l4} decays are also given. Author (ESRO)

N68-37137# Commissariat à l'Energie Atomique, Saclay (France). Centre D'Etudes Nucléaires.

CONTRIBUTION TO THE STUDY OF LIGHT NUCLEI WITH POLARIZED DEUTERONS [CONTRIBUTION A L'ETUDE DES NOYAUX LEGERS AU MOYEN DE DEUTONS POLARISES]

Jacques Arvieux Mar. 1968 220 p refs In FRENCH; ENGLISH summary

(CEA-R-3392) CFSTI: HC $3.00/MF $0.65

The vector and tensor-polarized deuteron source associated with the Saclay fixed energy (22 MeV) cyclotron is described briefly. This has been used to measure the deuteron asymmetry in d-α scattering (between 17.7 and 21.4 MeV) and in d-p scattering at 21.7 MeV. The formalism of irreducible tensor operators used to describe the polarization of a particle of given spin is developed and the helicity formalism used to describe the scattering amplitudes for scattering of deuterons by α (spin 0) and protons (spin 1/2) was studied. 1c1 r f224 149 w2. 149 w2. N68-37134 The results are applied to the phase shift analysis of scattering cross-sections and of deuteron polarization in d-α scattering from 10 to 27 MeV from which one obtains indications about the excited states of ^{6}Li, as well as proton and deuteron polarizations in p-d' (or d-p) scattering from 1.5 to 12 MeV so as to get the splitting (due to spin interactions) of P and D waves. Author (ESRO)

N68-37148# Hungarian Academy of Sciences, Budapest.

ON THE HIGH PRESSURE BEHAVIOUR OF HYDROGEN AND HELIUM

S. Barcza 1968 18 p refs

(Rept.-62) CFSTI: HC $3.00/MF $0.65

An exact equation of state was derived for hydrogen and helium at T = 0°K. For the derivation of the energy molar volume function a cellular method is applied using the boundary condition $\bar{\psi}_{\rho}(r)r=r_{s}=0$, where ρ and r_{s} are the electron density and the radius of the elementar sphere, respectively. This condition may be satisfied by $\bar{\psi}(r)r=r_{s}=0$ or $\bar{\psi}(r_{s})=0$. Both cases are examined. The modification of the Balmer series as a function of density is derived, and a qualitative indication suggesting the presence of a pressure ionization obtained, which may be of interest for geophysics. Author

N68-37154# Commissariat à l'Energie Atomique, Limeil (France).

EXPERIMENTAL STUDY OF THE INTERACTION OF 14 MeV NEUTRONS WITH ^{238}U [ETUDE EXPERIMENTALE DE L'INTERACTION DE NEUTRONS DE 14 MeV SUR ^{238}U]

Jean-Jacques Voignier Jul. 1968 58 p refs In FRENCH; ENGLISH summary

(CEA-R-3503) CFSTI: HC $3.00/MF $0.65

A study has been made of the interaction of fast neutrons with natural uranium from the experimental point of view over a wide energy range. The scattering energy spectra have been obtained by the time-of-flight method developed during previous work. The cross-section σ_{r} the elastic cross-section σ_{e}, and the inelastic neutron emission cross-section σ_{ne} have been measured at 14 MeV. The average number, $\bar{\nu}$, of neutrons produced by interaction is deduced from this last measurement. The experimental results are analyzed. The fission spectrum and the evaporation spectrum have been deduced from the energy spectrum of the secondary neutrons. The energy spectrum of the inelastic neutrons is represented by a relationship of the type: $N(E)=A\,E\exp(-E/Te)+B\sqrt{E}\exp(-E/T_{f})$ The parameter A, B, T_{e} and T_{f} have been evaluated. Finally the values obtained for the various cross-sections are compared with previous results. Author (ESRO)

N68-37156 International Centre for Theoretical Physics, Trieste (Italy).

PARTIAL WAVE ANALYSIS IN TERMS OF SL(2,C)/SU(2) HARMONIC FUNCTIONS

Awele Maduemezia Jul. 1968 18 p refs Submitted for publication

(IC-68-63) CFSTI: HC $3.00/MF $0.65

A new scheme for analyzing the scattering amplitude in the s-channel of a two-body elastic collision in terms of the representation functions of the covering group of the homogeneous Lorentz group is presented. The scheme uses representation functions defined on the homogeneous space SL(2,C)/SU(2), which for the equal mass case considered here is the same as the hyperquadric $q^{2}-q^{2}_{0}=-m^{2}$, where m is the particle mass, q is the relative centre-of-mass momentum (in the initial or final state) and $2q_{0}=\sqrt{s}$ is the centre-of-mass energy. The corresponding representations are multivalued and belong to the so-called degenerate (but not most degenerate) series. The scattering amplitude derived has the correct threshold behavior in the s-variable. Author (ESRO)

N68-37161# Nuclide Corp., State College, Pa.
FISSION PRODUCT ANALYSIS Final Letter Report
Leonard F. Herzog 13 Jan. 1968 7 p Prepared for Calif. Univ., Lawrence Radiation Lab.
(Contract W-7405-eng-48)
(UCRL-13344) CFSTI: HC$3.00/MF$0.65

The development of capillary tubes for ion transport, experiments with drift tubes, and development of a mass spectrometer for fission product analysis are briefly described. NSA

N68-37163# International Centre for Theoretical Physics, Trieste (Italy).
EQUAL TIME COMMUTATORS AND ELECTROMAGNETIC MASS SPLITTINGS
David G. Boulware and S. Deser (Brandeis Univ.) May 1968 54 p refs Submitted for publication
(Contract RCO-1388B; Grant AF-AFOSR-368-67)
(IC-68-34) CFSTI: HC$3.00/MF$0.65

The relation between electromagnetic mass shifts (or splittings) to order α and equal time commutators is analyzed. If the invariants in the forward spin averaged Compton amplitude go as k^{-2} for $k^2 \to \infty$, it is possible to relate the quadratic and logarithmic divergences in δm^2 to certain Lorentz scalars formed from the commutators. These results are illustrated by models with currents bilinear or linear in canonical fields. The Jost-Lehmann representation is then used to analyze more general behavior. It is shown that the spectral function may generate a higher rank tensor character of the amplitude than that expected from its kinematic factors. The relation is then more complicated even if the commutators still exist. Finally, detailed criteria for the existence of equal time commutators are developed; they imply that the Jost-Lehmann representation for the amplitude must be unsubtracted. Author (ESRO)

N68-37167# Polish Academy of Sciences, Warsaw.
STUDIES ON FIREBALL MODEL [ANALIZA MODELU FIREBALL I]
M. Miesowicz 1968 35 p refs Presented at the Meeting on the Fireball Model, Moscow, 11–15 Mar. 1968
(INR-P-915; CONF-680319-1)

Experimental facts are discussed which can be interpreted in terms of fireball emission in hadron interactions with energies in the interval 10 to 10^5 GeV. A detailed analysis of emulsion experiments at energies 10^3 GeV to 10^4 GeV is presented. A discussion of the role of isobars in particle production at $\approx 10^3$ GeV is given. Limitation on isobar mass and decay multiplicities resulting from observed anisotropy of pionization particles are discussed. The possibility of investigation of the physical nature of fireballs by studying interactions of nucleons with heavy nuclei is discussed. Author (NSA)

N68-37168# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
VECTOR MESON DOMINANCE MODEL AND π^+ PRODUCTION BY UNPOLARIZED AND LINEARLY POLARIZED PHOTONS
Margarete Krammer and Dieter Schildknecht Jun. 1968 35 p refs
(DESY-68/33)

Using the vector meson dominance model, it is shown that the polarization of vector mesons produced in meson nucleon collisions yields information on pion production by linearly polarized photons. Combining vector dominance and a quark model relation the cross section for charged pion production by linearly polarized photons is predicted. Moreover, the unpolarized π^+ cross sections calculated from the vector dominance and quark models are compared with recent experiments. Author (NSA)

N68-37172# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
USER'S MANUAL FOR THE BATTELLE-NORTHWEST ISOTOPIC DATA TAPE
R. L. Reynolds Nov. 1967 41 p
(Contract AT(45-1)-1830)
(BNWL-551) CFSTI: HC$3.00/MF$0.65

A computer program was prepared which provides an efficient means of using a data tape to survey selected aspects of isotopes, to identify isotopes by property, and to determine chains of nuclear processes. Author (NSA)

N68-37177# Rochester Univ., N. Y. Nuclear Structure Research Lab.
ISOSPIN IN TRANSFER REACTIONS. CHAPTER 13: ISOSPIN IN NUCLEAR PHYSICS
J. P. Schiffer and D. H. Wilkinson, ed. Aug. 1968 49 p refs
(UR-NSRL-6)

The role of isospin in transfer reactions is discussed in accordance with the usual practice of separating the spectroscopic aspects of nuclear structure from the reaction mechanism. The spectroscopic aspects are presented in terms of reasonably straightforward vector couping, and isospin-dependent sum rules are developed. Also included are tabulated data on one-nucleon, two-nucleon, and three-nucleon transfer reactions. Several ways in which the isospin affects the reaction mechanism are examined. A number of apparent anomalies in direct reactions are explained in terms of isospin-dependent effects on the form factors or in terms of effects from isospin coupling on the distorting potential of the incident, or outgoing channel. Among the isospin effects considered, are (1) resonance effects, (2) threshold effects, and (3) coupled channel calculations for isospin effects in direct relations. B.S.D.

N68-37178# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
DEPENDENCE OF NEGATIVE MUON RESIDUAL POLARIZATION IN WATER UPON TEMPERATURE
V. S. Evseev, V. S. Roganov, V. A. Chernogorova, G. Myasishcheva, and Yu. V. Obukhov 1968 5 p refs In RUSSIAN; ENGLISH summary
(JINR-P14-3832)

The asymmetry coefficient in the angular distribution of electrons from the μ^- decay was measured in water at various temperatures ranging from −196°C to +100°C by the muon spin precession method. The dependence of the residual muon polarization on the temperature was observed. This fact is entirely not explainable from the point of view of the cascade depolarization theory for isolated mesic atoms. The explanation of the dependence of the residual muon polarization on the t should be searched for, apparently, in the interaction of the produced mesic atom with medium. Author (NSA)

N68-37181# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
DEVELOPMENT OF THE HIGH TEMPERATURE ION SOURCE FOR THE GRENOBLE ELECTROMAGNETIC ISOTOPE SEPARATOR [ETUDE ET REALISATION DE LA SOURCE D'IONS A HAUTE TEMPERATURE DU SEPARATEUR ELECTROMAGNETIQUE D'ISOTOPES DE GRENOBLE]
Michel Bouriant (Ph.D. Thesis – Grenoble Univ.) Apr. 1968 30 p refs In FRENCH; ENGLISH summary
(CEA-R-3456) CFSTI: HC$3.00/MF$0.65

The production of high purity stable or radioactive isotopes (≥99.99 per cent) using electromagnetic separation requires for

equipment having a high resolving power. Besides, and in order to collect rare or short half-life isotopes, the efficiency of the ion-source must be high ($\eta > 5$ to 10 per cent). With this in view, the source built operates at high temperatures (2500-3000°C) and makes use of ionization by electronic bombardment or of thermo-ionization. A summary is presented of this work on the essential characteristics of the isotope separator ion sources: a diagram of the principle of the source built is then shown together with its characteristics. The values of the resolving power and of the efficiency of the Grenoble isotope separator fitted with such a source as given. The resolving power measured at 10 per cent of the peak height is of the order of 200. At the first magnetic stage the efficiency is between 1 and 28 per cent for a range of elements evaporating between 200 and 3000°C. Thus equipped, the separator has for example given, at the first stage, 10 mg of ^{180}Hf at (99.69 ± 0.1) per cent corresponding to an enrichment coefficient of 580; recently 2 mg of ^{150}Nd at (99.996 ± 0.002) per cent corresponding to an enrichment coefficient of 4.2×10^5 has been obtained at the second stage. Author (ESRO)

N68-37185# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
APPLICATION OF THE OPTICAL THEOREM FOR QUASI-ELASTIC SCATTERING TO THE PHOTOPRODUCTION OF VECTOR MESONS
G. Knies May 1968 7 p refs
(DESY-68/28)

Some consequences of the unitarity of the S-matrix to inelastic diffraction scattering processes are investigated. The application to the photoproduction of vector mesons leads to model independent lower limits on the total cross section for the production of hadrons by photons. Author (NSA)

N68-37190# Rochester Univ., N. Y. Nuclear Structure Research Lab.
PROTON PROTON BREMSSTRAHLUNG AT 20 MeV
A. Bahnsen and R. L. Burman Dec. 1967 9 p refs Supported by NSF
(UR-NSRL-3)

Details are given on an experiment in which the proton–proton bremsstrahlung (ppγ) was studied. In order to measure the ppγ cross section at 20 MeV beam energy, a hydrogen gas target was bombarded with protons from a tandem Van de Graaff, and two outgoing protons were detected in coincidence. The ppγ reactions were identified by the kinematic restrictions of the photon momenta. Several theoretical calculations for comparing experimental data are included. B.S.D.

N68-37192# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SOME PECULIARITIES OF PION CAPTURE BY HYDROGEN IN CHEMICAL COMPOUNDS
Z. V. Krumshtein, V. I. Petrukhin, L. I. Ponomarev, and Yu. D. Prokoshkin 1968 11 p refs In RUSSIAN; ENGLISH summary
(JINR-P13-3870)

The probability of the π^- meson capture by hydrogen in different chemical compounds (alkalies, salts, and pseudohydrides) has been measured. The obtained experimental results are well explained within the large-mesic-molecules model. In the case of compounds with q identical groups containing hydrogen, the probability of π^--meson capture by bound hydrogen is suppressed by a factor of q at the expense of quantum mechanical resonance. The probability of π^--meson capture in pseudohydrides is considerably less than in normal hydrides and this indicates that the structure of pseudohydrides is complex. Author (NSA)

N68-37193# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
NUCLEAR REACTIONS IN LIGHT NUCLEI AND MOSSBAUER STUDIES
Sep. 1967 169 p refs
(Contract AT(30-1)-2028)
(NYO-2028-2) CFSTI: HC$3.00/MF$0.65

Various papers on nuclear reactions in light nuclei and Mossbauer effect studies are summarized. The following are among the papers included: (1) use of a closed-cycle helium refrigerator for Mossbauer studies; (2) Mossbauer effect studies of ytterbium iron garnet; (3) laboratory fabrication of lithium-drifted germanium detectors for gamma rays; (4) nuclear polarization in the B^{11} (d,p) B^{12} reactions; (5) survey of beta-emitting nuclei with half-lives less than two minutes; and (6) observation of the Mossbauer effect in U^{238} following Coulomb excitation. B.S.D.

N68-37194# Hamburg Univ. (West Germany).
ANALYSIS OF THE PHOTOPRODUCTION OF ω MESONS
K. Schilling and F. Storim Deutsches Elektron-Synchrotron Jun. 1968 30 p refs
(DESY-68/23)

We analyse the recent bubble chamber data from the Aachen-Berlin-Bonn-Hamburg-Heidelberg-München Collaboration on the process $\gamma p \to p\omega$, assuming that ω photoproduction goes both via diffraction and via elementary pion exchange, where the latter is modified by final state absorption and by the intermediate $\rho^0 p$ state. Bearing in mind the simple assumptions made on the spin structure of the diffraction amplitudes, reasonable agreement of this model with the data is found. Author (NSA)

N68-37195# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
MEASUREMENT OF THE YIELD OF PHOTONS ON THE INTERNAL TARGET OF THE SYNCHROTRON [MESSUNGEN ZUR AUSBEUTE VON PHOTONEN AM INTERNEN TARGET DES SYNCHROTRONS]
E. Raquet and U. Timm May 1968 27 p In GERMAN
(DESY-68/24)

The efficiency and other features of bremsstrahlung production on an internal synchrotron target are investigated. Effects of target thickness, energy and collimation are investigated and summarized by a semi-empirical formula. The results show that the photon yield is nearly independent of target thickness. The angular spread, however, depends rather strongly on energy. The target extension has been investigated; one can conclude that point targets can be used without loss of yield. Reduction of angular spread in the photon beam by a scraper is demonstrated. Author (NSA)

N68-37197# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
TOTAL CROSS SECTION FOR PHOTOPRODUCTION OF HADRONS ON PROTONS UP TO 5 GeV
H. G. Hilpert, H. Schnackers, and H. Weber Jun. 1968 12 p refs
(DESY-68/31)

The total hadronic γ-proton cross section was measured for photon energies between 0.5 and 5.0 GeV. For this measurement the primary photon energy of photoproduction events in a hydrogen bubble chamber was determined by a counter arrangement. Author (NSA)

N68-37211# Institute of Nuclear Research, Warsaw (Poland).
^{6}He$_{\Lambda\Lambda}$ WITH NONLOCAL SEPARABLE INTERACTIONS WITH HARD SHELL $\Lambda\Lambda$ REPULSION

J. Dabrowski, M. Dworzecka, and E. Trych 1967 15 p refs
(INR-P-831/VII/PL)

The problem of $^{6}He\Lambda\Lambda$ treated as a $2\Lambda+\alpha$ system is solved exactly with a Yamaguchi nonlocal separable Λ-α potential, $V_{\Lambda\alpha}$, and a nonlocal separable Λ-Λ potential, $V_{\Lambda\Lambda}$, consisting of a long range attractive part plus a repulsive shell of radius c. The parameters of $V_{\Lambda\alpha}$ and $V_{\Lambda\Lambda}$ are adjusted to make the potentials equivalent to the local potentials $V_{\Lambda\alpha}$ and $V_{\Lambda\Lambda}$/ with hard core radius r_c/discussed recently. Numerical results for $B_{\Lambda\Lambda}/^{6}He_{\Lambda\Lambda}$/show that to get agreement with the experimental value of $B_{\Lambda\Lambda}$one has to choose $c<r_c$. Author (NSA)

N68-37212# Princeton Univ., N. J. Palmer Physical Lab.
MEASUREMENT OF THE ENERGY DEPENDENCE OF THE FORM FACTOR IN NEUTRAL KAON SUB L YIELDS PION PLUS ELECTRON PLUS NEUTRON DECAY
Samuel H. Aronson (Ph.D. Thesis) 14 May 1968 127 p refs
(Contract AT(30-1)-2137)
(PURC-2137-3; TR-3) CFSTI: HC $3.00/MF $0.65

A wide gap, magnetic field spark chamber spectrometer was used to measure the pion energy dependence of the form factor f_+ in $K^0_L \rightarrow \pi^\pm + e^\pm + \nu_e$ decay (K^0_{e3}). Decays of neutral particles were detected in the 13° beam of the Princeton–Pennsylvania Accelerator, and K^0_{e3}decays were identified by Kinematical reconstruction, time-of-flight, and by electromagnetic showers in Cherenkov shower counters. The distribution of events according to their pion energy in the K^0_L rest frame was used to determine the energy dependence parameter λ in the form factor $f_+(q^2) = f_+(0)(1 + \lambda q^2/m^2_\pi)$, where $q^2 = M^2_K + m^2_\pi - 2E_\pi M_K$. Based on a comparison of the data with the distribution of a Monte Carlo sample of events generated with constant form factor, λ was determined to be $\lambda = +0.020 \pm 0.013$. The data are consistent with the single particle dominance model, where the intermediate state is the $K^*(890)$. The results, taken together with the value of λ in K^+_{e3} decay are consistent with the predictions of the $|\Delta I| = 1/2$ rule in semileptonic decays. Author (NSA)

N68-37215# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
LECTURES ON RELATIVISTIC KINEMATICS
R. M. Muradyan 1968 28 p refs In RUSSIAN
(JINR-P2-3902)

The principal theses of the relativistic kinematices are considered. Author (NSA)

N68-37223# Paris Univ., Orsay (France).
SCHWINGER'S ANGULAR MOMENTUM CALCULUS AND THE DIRAC BRACKET
G. Gyoergyi and S. Koevesi-Domokos (Hungarian Academy of Sciences, Budapest) Mar. 1968 15 p refs
(IPNO/TH-123)

It is shown that the Schwinger angular momentum calculus can be obtained from the conventional three-dimensional rigid rotator (inertial motion of a mass point on a sphere). An essential tool to achieve this is the concept of the Dirac bracket. The quantization procedure proposed by Dirac for systems subject to constraints is adopted. The de Sitter dynamical group SO(3,2) serves as a framework of the treatment. NSA

N68-37227# Purdue Univ., Lafayette, Ind.
THE REACTION $\pi^+ d \rightarrow d\pi^+\pi^+\pi^-$ AT 2.7 GeV/c
D. Avison, J. Campbell, C. Ezell, J. Gezelter, S. Lichtman et al Jul. 1968 19 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-1428)
(COO-1428-83; (CONF-680809-2) CFSTI: HC $3.00/MF $0.65

Properties of the reaction $\pi+d \rightarrow d\pi+\pi+\pi-$ at 2.7 GeV/c are reported. The cross section is 150 μb. There is no significant evidence for production of mesons which decay to $\pi+\pi+\pi-$. The $d\pi$ and $\pi\pi$ mass spectra are discussed. The d^*++ and ρ^0 are strongly produced. It is shown that d^*0, which seems as copiously produced as d^*++, cannot be fully accounted for by reflections of the d^*++ or the ρ^0. The relevance of the one pion exchange model is discussed. Author (NSA)

N68-37229# Case Western Reserve Univ., Cleveland, Ohio.
AN EXPERIMENT FOR THE STUDY OF THE RADIATIVE K+ DECAY MODE TO BE PERFORMED AT THE ZERO GRADIENT SYNCHROTRON, ARGONNE NATIONAL LABORATORY
9 Jun. 1967 21 p refs
(Contract AT(11-1)-1749)
(COO-1749-4) CFSTI: HC $3.00/MF $0.65

An experiment is proposed to study the decay $K+ \rightarrow \pi+ + \pi^0$ using counters and spark chambers. A determination will be made of whether these events are really $K+_\gamma \rightarrow \pi+ + \pi^0 + \gamma$ and to what extent the photon is from inner bremsstrahlung. A description of this experiment is given including the experimental arrangement, expected event rate, and background. Also the experimental facilities are discussed. NSA

N68-37230# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
THE SPECTRUM OF VIBRATIONAL AND ROTATIONAL EXCITATIONS OF FOUR PARTICLE SYSTEM [SPEKTR KOLEBATEL'NYKH I VRASHCHATEL'NYKH VOZBUZHDENII SISTEMY CHETYREKH CHASTITS]
G. F. Filippov 1968 20 p refs In RUSSIAN
(ITF-68-14)

The vibrational and rotational spectrum of a four-particle system in which the two-particle interaction corresponds to the repulsion when distances between the particles are small and to the attraction otherwise is studied. In the case of four similar particles, the Hamiltonian of small vibrations is analogous to that of the generalized model for spherical nuclei and there is no lowlying rotational spectrum. In the case for which the inertia elipsoid of the equilibrium shape has a symmetry axis, the rotational spectrum makes its appearance. Author (NSA)

N68-37240*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EXCITATION SPECTRUM FOR A BOSE GAS WITH REPULSIVE AND ATTRACTIVE INTERACTIONS
Gerald V. Brown Washington Oct. 1968 69 p refs
(NASA-TN-D-4838) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The correct qualitative features of the helium II elementary excitation spectrum are derived microscopically for a realistic interatomic potential. The strong repulsive core is included by using a reaction matrix in the Hamiltonian. The attractive well is successfully included by assuming a generalized Bose–Einstein condensation. The pair Hamiltonian is diagonalized by the thermodynamically equivalent Hamiltonian method. Numerically solutions yield spectra with phonon and roton regions. The spectrum energies are too high for the Yntema–Schneider potential. Another potential, constructed to fit virial coefficient data classically, gives better results. Spectra are presented for a series of attractive well strengths. Author

N68-37243# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
PRODUCTION OF SINGLE NEUTRAL PION MESONS IN NEUTRAL PIONS IN POSITIVE PION XENON INTERACTIONS AT 2.34 GeV/c

B. Slovinskii and Z. S. Strugal'skii 1968 25 p refs In RUSSIAN (JINR-P1-3822)

The characteristics of π^0-mesons generated in π^+-Xe interactions at 2.34 GeV/c are investigated. Author (NSA)

N68-37244# Ceskoslovenska Akademie Ved, Rez.
LEVEL STRUCTURE OF IR 193
Z. Plajner, V. Brabec, L. Maly, and M. Vejs Oct. 1967 33 p refs
(UJV-1909)

The decay of ^{193}Os was studied with a 30-cm double-focusing β spectrometer, intermediate-image β spectrometer, lithium-drifted germanium detectors, and β-γ and γ-γ coincidence technique. Twenty-seven transitions were found, from which the 41.0-, 65.9-, 96.1-, and 185.5-keV transitions, were established for the first time. Two of them, the 41.0- and 65.9-keV transitions, were determined from coincidence information only. Internal conversion, gamma-ray, and gamma-gamma coincidence intensities are given. The multipolarities of some transitions were derived from relative internal conversion coefficients. The present data are consistent with a proposed decay scheme with excited states at 73.05, 138.95, 179.9, 362.3, 440.8, 460.8, 557.6, 559.5, 659.6, and 712 keV. The present decay scheme was analyzed in the light of the Nilsson model. Author (NSA)

N68-37262# Portugal. Nuclear Energy Commission, Sacavem.
LENGTH OF THERMAL NEUTRON DIFFUSION IN WATER AT 24°C [COMPRIMENTO DE DIFUSAO DE NEUTROES THERMICOS NA AGUA A 24°C]
E. Martinho and J. Salgado 1968 35 p refs In Portuguese
(Doc.-86) CFSTI: HC$3.00/MF$0.65

To determine the length of thermal neutron diffusion, separation of the neutron flux from the parallelepiped container, which is placed in access to the vertical column of the reactor, was maintained. The result, $L = 2.794 \pm 0.009$ cm, is compared with theoretical and experimental values. The cross section of the length of thermal neutron diffusion in water was found to be $d = 0.37 \pm 0.02$ cm, and is on the order of other findings. Transl. by F.O.S.

N68-37268# New York Univ., N. Y. Dept. of Physics.
LOWER BOUNDS ON PHASE SHIFTS FOR THREE-BODY SYSTEMS: N-D QUARTET SCATTERING
John Carew and Leonard Rosenberg Jun. 1968 19 p refs Sponsored by NSF

The Faddeev equations are used to provide a variational bound formulation of the three body scattering problem. The present method has the distinct advantage that the Feshbach projection operators, which enter into previous formulations, and which are generally difficult to construct, do not appear. The method requires the calculation of a variational approximation to the exact effective potential for the scattering of a particle by a bound two body system. A reation matrix is determined by using this effective potential as input to a two body Lippmann-Schwinger equation which is easily solved numerically. The eigenphase shifts thus obtained provide lower bounds on the true eigenphases for energies below the three body break-up threshold. To test its practicability the method is applied to the problem of neutron-deuteron scattering in the quartet state. The results are in agreement with previous calculations and with experiment. Author

N68-37274# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RELATIVISTICALLY COVARIANT WAVE EQUATIONS FOR N PARTICLES IN THE QUANTUM FIELD THEORY
V. A. Matveev, R. M. Muradyan, and A. N. Tavkhelidze 1968 20 p refs In RUSSIAN; ENGLISH summary
(JINR-P2-3900)

The relativistically covariant equations for N particles are derived on the basis of the quasi-potential method of the quantum field theory. Author (NSA)

N68-37322# Oak Ridge National Lab., Tenn.
ELECTRON MEAN FREE PATHS IN A FREE ELECTRON GAS
R. N. Hamm (Ph.D. Thesis—Tenn. Univ.) and R. H. Ritchie, and J. C. Ashley Jul. 1968 74 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2072)

The scattering of an incident electron with an electron lying in the Fermi sea is considered. The incident electron and the struck electron which is ejected from the Fermi sea may then scatter from each other repeatedly. Matrix elements for these scatterings are written down using the techniques of many-body perturbation theory. The exclusion principle is taken into account explicitly for each scattering event, since the particles after the collision must both be found outside the Fermi sphere in momentum space. The resulting expansion for the matrix element is seen to be a Neumann expansion for the solution of an integro-differential equation in momentum-space. Following Bethe and Goldstone this equation is converted into a Schroedinger-like wave equation in configuration space in which an integral operator contains the effect of the exclusion principle. The equation is solved numerically and the scattering cross section is calculated from the s-wave phase shifts. Author (NSA)

N68-37337# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE COUPLING OF MATTER AND RADIATION IN COSMOLOGY
Henri E. Mitler 15 Jul. 1968 83 p refs
(SAO-SR-281)

The calculation of the time dependence of the temperature of the matter and radiation in an expanding universe, in the early stages of which nuclear reactions take place, is presented. The present treatment differs from more conventional ones in that (1) it begins with a cold neutron universe (no leptons); (2) it computes explicitly the contribution made to the heat content by the exothermic nuclear reactions, and (3) the temperature is calculated exactly, rather than by the $T \propto R^{-1}$ approximation. In order to find the temperature at which decoupling of matter and radiation take place, the Saha equation is solved in a self-consistent way. The energy gain of an electron gas through free-free absorption is calculated to second order in the temperature difference. Decoupling is found to take place between about 4500°K and 2500°K. Author

N68-37338# Argonne National Lab., Ill.
DISTRIBUTION OF CHARGE IN TH 232 AND U 238 DETERMINED BY MEASUREMENTS OF MUONIC RAYS
R. E. Cote, W. V. Prestwich, A. K. Gaigalas (New York State Univ., Binghamton), S. Raboy (New York State Univ. Binghamton), C. C. Trail (City Univ. of New York, Brooklyn) et al [1968] 40 p refs Supported in part by AEC
(Grant NSF GP-6213)

The energies and intensities of the X rays of muonic atoms of Th^{232} and U^{238} were measured. Analysis of the data was performed using the rotational model of strongly deformed nuclei to include dynamic quadrupole interactions. The distribution of nuclear charge was represented by a modified Fermi Distribution which involves three parameters, namely: (1) Q_0, the intrinsic quadrupole moment; (2) $c/c = c_0 A^{1/3}$, the half-density radius; and (3) t, the skin thickness. It was found that the allowed ranges of values for Q_0, c_0 and t were: for thorium 9.58–9.83 b, 1.155–1.143 F, and 1.54–1.87 F; and for uranium, 11.20–11.41

b, 1.150–1.152 F, and 1.600–1.87 F, respectively. If specific values for two of these parameters are chosen, the third is determined with an error smaller than the above ranges. Author

N68-37351 Technische Hochschule Hannover (West Germany).
THE USE OF A NON-CENTRAL VELOCITY DEPENDENCE POTENTIAL FOR INTERPRETING THE NUCLEON-NUCLEON-SCATTERING IN THE RANGE FROM 10 MeV TO 300 MeV LABORATORY ENERGY [UEBER DIE VERWENDUNG EINES NICHTZENTRALEN GESCHWINDIGKEITSABHAENGIGEN POTENTIALS ZUR INTERPRETATION DER NUKLEON-NUKLEON-STREUDATEN IM BEREICH VON 10 BIS 300 MeV LABORENERGIE]
Kurt Appel (Ph.D. Thesis) 1967 89 p refs In GERMAN
CFSTI: $3.00

Calculated is the energy structure of nucleon-nucleon scattering phases at 10 to 300 MeV at the potential of $V = v_l + v_t + v_{\delta p}$ where the nucleon-nucleon potential V is determined by the random and velocity dependent potential $v_{\delta p}$. The use of this velocity dependent potential makes it possible to couple primary and secondary wave function derivatives and to consider resonances in the various triplet states. Data tables for calculated proton-proton scattering and neutron-proton scattering are included. Transl. by G.G.

N68-37371# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CONNECTION BETWEEN THE BRUECKNER REACTION MATRIX AND THE EFFECTIVE FORCE OPERATOR FOR THE NUCLEAR RPA
I. N. Mikhailov 1968 16 p refs In RUSSIAN
(JINR-P4-3849)

A possibility of determining the effective force for the nuclear RPA by using the existing calculations of the binding energy in nuclear matter and finite nuclei was studied. Author (NSA)

N68-37372# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EFFECTIVE FORCE FOR THE NUCLEAR VARIANT OF THE RPA
I. N. Mikhailov 1968 18 p refs In RUSSIAN
(JINR-P4-3873)

The nuclear RPA equations have been obtained from the formally precise relations, allowing one to analyze the renormalization of the effective force which determines the structure of the lowest states of nuclei. Author (NSA)

N68-37374# Institute of Mathematical Science, Madras (India).
LECTURES ON NUCLEAR MODELS AND NUCLEAR MATTER
K. Srinivasa and R. Sridhar [1967] 202 p refs
(MATSCIENCE-57)

Lectures dealing with the classification of nuclear models, the liquid-drop model, the shell model, the optical model, the unified model, and nuclear reactions are included as are lectures dealing with various aspects of the theory of nuclear reactions such as time-dependent and -independent perturbation methods, the second-quantization approach to the many-body problem, the Hartree–Fock method, the Brueckner theory, and the Moszkowski and Scott separation method. NSA

N68-37388# Paris Univ., Orsay (France).
EXPERIMENTAL SET-UP FOR ELECTRON SCATTERING STUDIES AT 180° [ETUDE D'UN APPAREILLAGE PERMETTANT LA MESURE DE LA DIFFUSION DES ELECTRONS A 180°]
D. Ganichot, D. Benaksas, B. Grossetete, D. B. Isabelle, and J. Lorrain Nov. 1967 25 p refs In FRENCH; ENGLISH summary
(LAL-1182) CFSTI: HC $3.00/MF $0.65

We built an experimental set-up for electron scattering studies at 180°. The optical properties of our system have been determined from field mapping. As a check we performed an experiment on hydrogen and we found that the tail of the elastic peak was modified due to the presence of background electrons. This set-up, as with all other systems for measuring electron scattering at 180°, includes an auxiliary magnet which is responsible for this background. This effect was demonstrated and we were able to eliminate it. Conclusions are drawn about the general technique of such experiments. Author

N68-37392 Harvard Univ., Cambridge, Mass.
MOLECULAR BEAM AND MASER RESEARCH Annual Progress Report
Norman F. Ramsey 13 Mar. 1968 4 p refs
(Grant NSF GP-6194)

Molecular beam and atomic hydrogen maser investigations are reviewed. Spherical tops such as CH_4, CF_4, and SiH_4 were studied, a nozzle beam source was developed for the molecular beam resonance apparatus, and an apparatus is being designed in which electric and magnetic fields can be applied simultaneously in the resonance region and in which molecules can be detected with an electron bombardment detector. Agreement between the Breit-Rabi formula and experimental results was found to be excellent, and a new procedure was developed for analyzing the effects on nonuniform magnetic fields upon field dependent lines in hydrogen masers and other resonant cavities was developed. Other hydrogen maser efforts deal with storage bulb surfaces, alkali resonance beams, and a storage vessel with 60" diameter. M.W.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-36023 Stanford Univ., Calif.
ION OSCILLATIONS IN AN ELECTRON BEAM GENERATED PLASMA
Joseph William Christie (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17403

The work reported here is concerned with the oscillatory phenomena associated with an electron beam passing through partially ionized, low pressure gas. Three distinct physical regimes are defined, namely: the very low pressure regime where the residual ion density is a negligible fraction of the electron beam charge density, the low to moderate pressure region where the residual ion density is a significant fraction or even equal to the electron beam charge density, and the third regime where the moderate gas pressure allows the ion density to be equal or significantly exceed the electron beam charge density. In those regions where the ion density is significant various workers have observed the presence of low frequency, typically in the megacycle region, oscillations in the electron beam current. These oscillations have been generally assumed to be associated with the ion system and appeared to be motions where the charged particles moved in a predominantly perpendicular direction to the electron beam drift direction. Dissert. Abstr.

N68-36058 Stanford Univ., Calif.
PLASMA HEATING AND DIFFUSION IN STOCHASTIC FIELDS
Satish Puri (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-17485

Comparison was made between an experiment on plasma heating by stochastic electric fields with a theory developed during this work. A collisionless, lossless, "test particle" plasma is found to extract energy from an electric field both in the absence and the presence of a magnetic field. The study of the motion of electrons in a static magnetic field and a transverse random electric field allows us to determine the particle heating and diffusion rates in terms of the power spectrum of the fluctuating electric fields of arbitrary strength. The analysis assumes that each particle independently experiences a stationary random electric field. Computer studies show that the plasma has a marked tendency to assume a Maxwellian distribution when the particles move along a sinusoidally varying magnetic field instead of a uniform magnetic field even if they all see the random electric field. Further, it is found that the plasma heating rate is unchanged when small random fluctuations are introduced in the magnetic field variation as seen by the particle. A tenuous collision-free sodium plasma in thermal equilibrium between two mirrors was heated by an externally applied random electric field. Dissert. Abstr.

N68-36083 Cornell Univ., Ithaca, N. Y.
PROBLEMS IN MACROSCOPIC AND KINETIC PLASMA THEORY
Giovanni Emilio Perona (Ph.D. Thesis) 1967 212 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17249

The first section is a study of normal ionizing shock waves. After a preliminary review of some of the work done in this field, the shock equations are integrated for a very simple model. Diagrams describing the shock structure for different initial values are given, and the main features of the structure are discussed. As a physical example we have numerically integrated the equations governing the shock structure for Argon. We show that the results of these calculations justify the use of the main assumptions made in deriving the equations. The results of the numerical integration are displayed. The second section is a study of the BBKGY equations. These equations are written in nondimensionalized form, leaving two parameters, α and β, explicit. The s-particle distribution function is expanded about vanishing correlation with ϵ entering as a parameter of smallness. Nine cases are considered depending on the order of magnitude of α and β (viz., ϵ, 1, ϵ^{-1}). We show that the lowest order terms, in each of the cases considered, give a kinetic equation together with subsidiary conditions. A critical survey is made of the compatibility problem, which is inherent to expansions of the BBKGY sequence. Dissert. Abstr.

N68-36089 California Inst. of Tech., Pasadena.
PART 1: EXPERIMENTAL INVESTIGATION OF AN ARC-HEATED SUPERSONIC FREEJET. PART 2: ANALYSIS OF ONE-DIMENSIONAL ISENTROPIC FLOW FOR PARTIALLY IONIZED ARGON
Arvel Benjamin Witte (Ph.D. Thesis) 1967 265 p
Available from Univ. Microfilms: HC $11.95/Microfilm $3.45 order No. 67-17081

An experimental investigation of the flow field of a highly ionized supersonic free jet has been carried out in a continuous flow test facility. Measurements of impact pressure, mass flux, total enthalpy and stagnation point heat transfer profile were made in this flow field with two water cooled probes. Argon gas, at a flowrate of 0.5 gm/sec, was heated in a magneto-plasma-dynamic arc heater without an external magnetic field operating from between 200 amp and 40 volts to 1000 amp and 25 volts. One dimensional isentropic flow variables of partially ionized argon have been calculated by coupling the isentropic flow equations with the partition-function method of deriving equilibrium thermodynamic properties. The gas properties computed for this flow process include the sound speed, entropy, enthalpy, electron concentration, ionization fraction, electrical conductivity and static-to-stagnation ratios of temperature, pressure, and density. Dissert. Abstr.

N68-36140 Missouri Univ., Columbia.
COLLISIONAL DAMPING OF WAVES IN AN ELECTRON PLASMA
Hari Gopal Mukerjee (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-319

Collisional damping of longitudinal waves has been calculated for an electron plasma. The hierarchy of equations has been truncated by neglecting the triplet correlation. The resulting set of equations has been linearized about an equilibrium Maxwellian distribution. Using an operator technique the equation for the pair correlation has been solved in terms of one particle distribution functions, and a kinetic equation is obtained. A dispersion relation for the wave has been derived from the kinetic equation, and the collisional damping decrement has been calculated. The temperature dependent correction to the oscillation frequency is found to be small. Expanded to the lowest significant order of the wave number the collisional damping is found to be proportional to the square of the wave number. Although Landau damping is dominant at short wavelengths, collision is found to be the dominant mechanism for damping at long wavelengths. Dissert. Abstr.

N68-36145 North Carolina State Coll., Raleigh.
THE KINETIC THEORY OF FORCED OSCILLATIONS IN PLASMAS
Gary Alan Massel (Ph.D. Thesis) 1967 230 p
Available from Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 67-17886

The kinetic theory of forced oscillations in plasmas is developed with emphasis on examining both the collective properties and the streaming properties of the system. The streaming properties play no role in free oscillations; however, they are frequently a dominant contribution in forced oscillations. Considering forced oscillations necessitates taking the effect of an external source into the theory. The theory is developed and applied to three plasma models, describing both collisionless and collisional propagation. One of the plasma models describing the transition from collision dominated to collisionless propagation of ion-acoustic waves has been used for the first time in this application and the theoretical description is in good agreement with experimental results. The techniques which are developed are also applied to the problem of neutron diffusion using a modulated neutron source. Dissert. Abstr.

N68-36157# Harry Diamond Labs., Washington, D. C.
MERCURY ARC PLASMA TUBE DIAGNOSIS STUDY. PART 1: LANGMUIR PROBE STUDY
William L. Vault and John A. Rosado Jun. 1968 35 p refs
(HDL-TR-1394; AD-673699)

A Langmuir probe analysis of the plasmas generated by the HDL Mercury arc facility was performed to determine electron density and temperature. The electron temperature data are presented in tabular form as a function of the discharge current. Electron density profiles were constructed from the electron density data and are given in graphic form. A review of the theory of positive ion collection by a negative probe in plasma is also included. Author (TAB)

N68-36158# Harry Diamond Labs., Washington, D. C.
EQUILIBRIUM THERMODYNAMIC PROPERTIES AND ELECTRON CONCENTRATIONS OF CESIUM-ARGON MIXTURES BEHIND INCIDENT AND REFLECTED NORMAL SHOCK WAVES
Harry J. Davis and Rosalie C. Woodall May 1968 54 p refs
(HDL-TR-1388; AD-673698)

The equilibrium temperature, density, pressure, and electron concentration of cesium-argon mixtures behind incident and reflected normal shock waves were calculated. Presented are the results for p sub 1 = 1, 2, 5, and 10 mm Hg; n sub cs/n(total) = .005, .01, .03, and .05; 1.0 < or = M sub S < or = 10.8. Subsidiary calculations show the effect of the cesium partition function, initial gas temperature, and argon ionization in specific cases. Author (TAB)

N68-36199# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROMAGNETIC INSTABILITIES OF PLASMA
Chyuan-Kong Loh Aug. 1967 14 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (China), v. 20, no. 4, 1964 p 289-296
(FTD-HT-66-499; AD-673188)

Using a method similar to Penrose (Phys. Fluids, 3, 1960, 258), an instability criterion for electromagnetic waves in plasmas with anisotropic velocity distribution is obtained by analyzing the geometrical properties of dispersion relation. The effect of temperature nonhomogeneity on instability and that of particle beams are discussed. Finally, a formula for the first ordered relativistic connection for Wiebels rate of growth of the electromagnetic waves is given. Author (TAB)

N68-36207# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
THEORETICAL STUDY OF PROPERTIES DUE TO THE CURVATURE IN THE TOROID SHAPE IN MAGNETOHYDRODYNAMICS
Jean-Claude Adam Mar. 1968 68 p refs In FRENCH; ENGLISH summary
(CEA-R-3490; EUR-3857)

A toroidal plasma centered around a closed Γ is considered. When the rotational transform $\Gamma'/2\pi$ approaches an integer k, curvature effects are very important. When the rotational transform is created by current flowing in the plasma the coefficient a_k of the Fourier expansion of curvature $1/R(s)$ is not zero. One finds then that the influence of a_k is predominant and that it is possible to neglect all the other members of the series to study the neighborhood of the corresponding equilibrium singularity. By developing an adapted coordinate system it is thus possible to take into account curvature effects at the lowest order. Equilibrium study brings one to introduce an equilibrium parameter $\nu \leq 1$ characterizing curvature effects. It is shown that when θ is near 1 the more shear and V'' (Ψ) quantities occurring in the stability criterion are important. Finally, the stability investigation shows that the larger the integer k the smaller the domain of stability, when $L/2\pi$ is near k. Author (NSA)

N68-36211 California Inst. of Tech., Pasadena.
MASS SPECTROMETRIC STUDIES OF IONIZATION IN SHOCK HEATED GAS MIXTURES
Charles Chang-Ping Wang (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-17078

The initial stage of thermal ionization in gas mixtures behind strong normal shock waves has been studied using a mass spectrometer. The sampling process, the unique role of mass spectrometric analysis, the ionization mechanism and the effect of impurities on the ionization relaxation time of the inert gases are discussed. A detailed analysis of ion diffusion through the end wall thermal boundary layer to investigate the effect of the sampling process on the reaction and reaction products are described. The experiments were conducted in argon and xenon at temperatures of from 10,000°K to 30,000°K and pressures from 15 mmHg to 80 mmHg. A large number of different ions were detected in pure (the estimated level of naturally occurring impurities was 50 ppm) argon. H+ and O+ were found in much greater amounts than any of the other products. The roles of H and O were studied further by mixing a small amount of H_2 or O_2 in argon. Dissert. Abstr.

N68-36214 Washington Univ., St. Louis, Mo.
NONLINEAR OSCILLATIONS IN A MAXWELLIAN PLASMA
Stephen Peter Gary (Ph.D. Thesis) 1967 70 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-17183

This dissertation treats a theory of nonlinear plasma oscillations in a classical, non-relativistic, collisionless, Maxwellian electron gas of finite extent. Both longitudinal and transverse waves are studied by considering the initial value problem for certain initial perturbations of order ϵ. The nonlinear Vlasov equation is solved to second order in the long time limit, and the spatially homogeneous part of the distribution function is then included as an iterative correction to the linear theory. For longitudinal oscillations this second order correction is shown to be significant for many values of ϵ and wavenumber, and in the long time limit can lead to a reduction in magnitude of the damping decrement. Thus some of the results of Knorr and Armstrong, obtained by numerical integration of the nonlinear Vlasov equation, are explained. Dissert. Abstr.

N68-36246# Pennsylvania Univ., Philadelphia. Towne School of Civil and Mechanical Engineering.
DIFFUSION OF PRECURSOR IONS AND ELECTRONS UPSTREAM OF A STRONG SHOCK WAVE PROPAGATING DOWN A SHOCK TUBE. 2: ELECTROSTATIC POTENTIAL DISTRIBUTIONS
Ira M. Cohen May 1968 28 p
(Grant NSF-GK-1652/2)
(Rept.-1652/2; PB-178681) CFSTI: HC $3.00/MF $0.65

Dominant order electrostatic potential distributions are considered consistent with the charged particle densities which were found based on a formulation of the diffusion aspect of the precursor photoionization problem in a shock tube discussed in an earlier report. The limits of large photoionization rate and shock speed and small ratio of ion to electron diffusion coefficients are treated. Solutions for potential in each of the seven regions (which appear in the asymptotic formulation) are obtained and matched in the overlap domain between adjacent regions. The relevance to experiments is discussed. Author (USGRDR)

N68-36251 California Inst. of Tech., Pasadena.
MAGNETOHYDRODYNAMIC SHOCK PRODUCTION AND CURRENT SHEET DIFFUSION
Alan Lowell Hoffman (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-17064

Current sheets in inverse pinch MHD shock tubes exhibit the strange property of forming shocks in the very rear of the sheet when accelerating heavy gases. When accelerating light gases, shocks are formed further to the front in the sheet, but in no case do the shocks separate from the driving current sheet. This piston dragging shock effect is explained on the basis of a single fluid model with variable conductivity. Shocks are shown to always form within current sheets which move at supersonic speeds with respect to the driven gas. The relevant parameters for determining the

shock position are the Mach number and the magnetic Reynolds number. Large magnetic Reynolds numbers and small Mach numbers enhance forward shock formation. These conditions are obtained in light gases with high speeds of sound. Similarity methods are developed to estimate gas conductivities, electron temperatures, and degrees of ionozation for the experiments which are conducted. Dissert. Abstr.

N68-36252 California Inst. of Tech., Pasadena.
AN EXPERIMENTAL INVESTIGATION OF THE STRUCTURE OF REFLECTING, IONIZING SHOCKS IN XENON
Jerome Allan Smith (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-17074

The results of an experimental investigation of the reflection of strong shocks in xenon from the end wall of the GALCIT 6" shock tube are presented. The reflection of the incident shock structure, consisting of a frozen shock front, a region of relatively uniform frozen flow, and an ionization front, was observed with a fast-rise (0.3 μ sec) pressure gauge mounted in the shock tube end wall. The interaction between the reflecting shock and the ionizing gas in the incident shock structure was of particular interest. This interaction produces a complicated series of shock and rarefaction waves; those waves that propagate back to the end wall were observed with the pressure gauge. The incident shock Mach number was varied from 11 to 20, and the initial pressure was varied from 0.1 to 1.5 mm Hg. Dissert. Abstr.

N68-36259# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
OPTICAL AND MICROWAVE MEASUREMENTS OF 2450 MHz DISCHARGES IN N_2
L. A. Middleton and R. E. W. Jansson Nov. 1967 14 p refs
Presented at the Conf. on Electrodeless Breakdown in Gases, Including Laser Produced Breakdown, C.E.R.L., Leatherhead, 21–22 Sep. 1967
(AASU-287)

The optical emission from 2450 MHz discharges (near S-band) in N_2 was measured over the range 3000 Å to 8000 Å. Using band strengths which were calculated theoretically, the intensities of individual transitions were turned into relative populations of the vibrational levels in some excited states. Above about 1 torr the relative populations in the $B^3\Pi_g$ and $C^3\Pi_u$ states may each be described in terms of a single vibrational temperature. The vibrational temperature of the B state remains constant at 9450° ± 250°K over the pressure range 1.0 to 8.0 torr, while that of the C state decreases from 10,200° ± 250°K to 5200° ± 250°K. It was estimated by other means that the temperature of the neutral gas was about 300°K. Below about 1 torr the vibrational population distribution can no longer be described in terms of a single temperature, and the emitted intensities then give information about the excitation processes. During these experiments the electron (ion) density in the discharge was monitored by the frequency shift of a tuned X-band cavity filled with the discharge plasma; the change in Q of the same cavity gave an estimate of the collision frequency for momentum transfer. Author

N68-36265 Stanford Univ., Calif.
MICROINSTABILITIES AND DIFFUSION PROCESSES IN A THERMAL PLASMA
Miklos Porkolab (Ph.D. Thesis) 1967 213 p
Available from Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-17483

It is of great importance in plasma physics to understand the physical mechanisms which produce microinstabilities, to determine their behavior under various conditions, and to study their effects upon plasma motion. Theoretical and experimental evidence indicates that oscillations due to small scale instabilities may produce considerable turbulent diffusion. Because excessive turbulent diffusion would prevent the achievement of controlled thermonuclear fusion, it is of importance to know the rate at which plasma diffusion across magnetic field in the presence of random electric fields. The present work is directed towards finding answers, both experimentally and theoretically, to some of the foregoing questions. In spite of the inherent difficulties, an attempt is made to amalgamate theory and experiment throughout this work. In this work the physically significant aspects of most of the experimental results are explained by the use of simplified theoretical models. Dissert. Abstr.

N68-36311 Purdue Univ., Lafayette, Ind.
ON THE THEORY OF THE PLASMA RESONANCE PLANE PROBE
Nelson Chin-Shui Li (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-16673

It is shown theoretically how a conducting plane probe behaves when it is immersed in a plasma, and has both a DC and an RF potential applied to it. The rectified current which flows to the probe is derived as a function of the frequency of the applied voltage. Resonance phenomena is shown to occur at a frequency somewhat less than the plasma frequency. The collisionless Boltzmann–Vlasov equation, together with Poisson's and Maxwell's equations are used to derive respectively, the DC potential distribution based on Bohm's sheath model, and the integral equation governing the alternating electric field in the plasma. The alternating electric field is calculated numerically and the calculations show the penetration of the RF electric field into the plasma. The rectified electron current and its resonance rectification are obtained by a consideration of electron trajectory perturbations produced by the RF electric field. Collisions are neglected and all magnetic fields effects are omitted. Dissert. Abstr.

N68-36317*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRANSPORT EQUATIONS FOR GASES AND PLASMAS OBTAINED BY THE 13-MOMENT METHOD: A SUMMARY
K. G. Harstad 1 Oct. 1968 16 p refs
(Contract NAS7-100)
(NASA-CR-97148; JPL-TR-32-1318) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A summary of results obtained from 13-moment solutions to the Boltzman equations for a gas mixture is presented. The simplifications that can be achieved when one of the components has a small mass are discussed. A calculation of electron-atom collision parameters for noble gas atoms with Ramsauer cross sections (A, Kr, Xe) is also given. Author

N68-36327 California Univ., Berkeley.
ELECTRICAL BREAKDOWN OF HYDROGEN ACROSS A STRONG MAGNETIC FIELD IN COAXIAL GEOMETRY
Arthur Robert Sherwood (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-156

The formative time of electric breakdown in low pressure (0.2 to 2.0 torr) hydrogen across a strong magnetic field ($10 < \omega_b\tau < 350$; maximum B of 18 kG) has been measured in a coaxial cylindrical geometry. Attention was centered on that region of breakdown that occurs with a formative time less than the time required for an electron to drift across the electrode gap in the applied fields. This crossing time was inferred by extrapolations of previous measurements by Bernstein. These formative time measurements are compared with a simplified theory which assumes a constant number of e-folding times until breakdown and neglects electron losses as well as secondary production at the cathode. This model predicts that the formative time is inversely proportional to the gas pressure and otherwise a function of only the ratio E/B

and not of either field separately. The predicted pressure dependence is confirmed, but deviations from the predicted functional dependence on E/B are found. These deviations are attributed to electron losses along the magnetic field. Reasonable agreement with the predicted magnitude of the formative time is obtained. Dissert. Abstr.

N68-36362*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
PROBLEMS OF INTENSE MAGNETIC FIELD IN GRAVITATIONAL COLLAPSE
Hong-yee Chiu and Vittorio Canuto [1968] 16 p refs
(NASA-TM-X-61285) CFSTI: HC $3.00/MF $0.65 CSCL 03B

During gravitational collapse, magnetic fields of the order of 10^{14} gauss can be achieved. The quantum theory of an electron gas in such a field was developed and the major results are reported. The equation of state, the spontaneous magnetization, and the spontaneous pair creation are discussed. It is shown that spontaneous pair creation can be achieved only when the anomalous magnetic moment of the electron is included in the Dirac equation. The number of created pairs is explicitly given. Author

N68-36471# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE Quarterly Progress Report
J. L. Shohet 15 Jun. 1968 18 p refs
(Contract AT(11-1)-1695)
(COO-1695-10; QPR-5) CFSTI: HC $3.00/MF $0.65

The electron cyclotron resonance device was operated to obtain additional free-free bremsstrahlung measurements, plasma diamagnetism, energetic electron flux and electron density in the discharge. The brush cathode gun was operated as a PIG discharge. Aluminized, scintillators were placed in the axial and radial directions in the vacuum chamber. Radio frequency emission from the plasma was observed. An instability in the operation of the device was observed. Theoretical work is under way to determine the nature of this instability as well as a new method for evaluating the eigenfrequencies of a microwave cavity filled with a plasma of variable density. NSA

N68-36483# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL PROTECTION OF CLOSED SOLENOID [ELEKTROZASHCHITA ZAMKNUTOGO SOLENOIDA]
P. Ya. Burchenko, Ye. D. Volkov, A. V. Georgiyevskiy, V. Ye. Ziser, and L. Kh. Kitayevskiy 30 Jun. 1967 10 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Fiz.-Tekhn. Inst. (Kharkov), no. 216/R-069, 1966 p 3-6
(FTD-MT-67-85; AD-673660)

Large thermonuclear installations commonly have closed solenoid magnetic systems for confinement of plasma. When trouble occurs in the solenoid circuit destruction of the magnetic system and allied assemblies may result. Hence the problem of reliable protection of the solenoid becomes urgent. The authors propose a method and describe an effective device for electrical protection of a closed solenoid. TAB

N68-36521# Sperry Rand Research Center, Sudbury, Mass.
VELOCITY SPACE INSTABILITIES IN A SIMULATED FUSION PLASMA AND LASER GENERATION OF PLASMA Final Report
Warren D. McBee and David L. Morse Jun. 1968 48 p refs
(Contract AF 49(638)-1541)
(SRRC-CR-68-33; AFOSR-68-1756; AD-673512)

The dispersion of electrostatic waves in a cesium plasma produced by thermal ionization and penetrated by a lithium ion beam is investigated. It is shown that if the ion beam has an anisotropic velocity distribution, instabilities can arise which are analogous to velocity-space instabilities observed in some controlled thermonuclear fusion plasma experiments. Damping of the instabilities due to electron-neutral collisions and thermal velocities of the electrons and lithium beam ions is considered. For the parameters of the experiment, the predominant damping mechanism is the thermal velocity distribution of the lithium beam ions, and the damping is sufficiently strong to explain the absence of observed spontaneous oscillations. The physical mechanisms involved in the production of plasma by intense light pulses from a Q-switched laser are considered. An estimated time schedule is given for the production, expansion, and loss of such a plasma created in a magnetic containment system. The development and testing of a high-peak-power neodymium-glass Q-switched laser is outlined. The design of a nozzle to produce a jet of cesium vapor through the laser focus of sufficiently high density to allow laser induced breakdown is described. Author (TAB)

N68-36549*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF SHOCK-TUBE PRECURSORS
A. J. Mulac Sep. 1968 142 p refs
(Grant NGR-05-020-245)
(NASA-CR-97190; SU-DAAR-358) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Electrical precursor phenomena under a broad spectrum of conditions have been studied with a potential probe suspended in a metal shock tube. These data were supplemented with qualitative biased probe measurements. Strong negative signals were observed with the potential probe from one to two shock-tube diameters ahead of argon shocks (M_s = 6.5 to 16, p_1 = 2.5 to 10 Torr) and nitrogen shocks (M_s = 10.5 to 15, p_1 = 5 Torr). Photoemitted electrons from the shock tube and probe surfaces were observed far ahead (meters) of both argon and nitrogen shock waves. Photoionization of the test gas and/or impurity gases was detected ahead of very strong (M_s > 14) shocks in argon. The shock heated test gas, as opposed to the combustion driver gases, was determined to be the radiation source for the above radiative phenomena. No precursors were observed in helium for $M_s \leq 9.2$ and p_1 = 5 Torr. A theoretical model was formulated to explain the low Mach number (6.5 to 9.0) argon experimental results. The model couples very small scale electron diffusion at the translational shock front with simple, but three dimensional, electrostatics. This model predicts the observed precursor-potential profile in terms of a dipole type structure at the translational shock front. Author

N68-36611# Pennsylvania Univ., Philadelphia. Towne School of Civil and Mechanical Engineering.
DIFFUSION OF PRECURSOR IONS AND ELECTRONS UPSTREAM OF A STRONG SHOCK WAVE PROPAGATING DOWN A SHOCK TUBE
Ira M. Cohen Feb. 1968 45 p refs
(Grant NSF GK-1652)
(Rept.-165211; PB-178680) CFSTI: HC $3.00/MF $0.65

Photoionization upstream of strong shock waves produces ion-electron pairs. These charged particles diffuse to the walls of the shock tube where they recombine unless they are first overtaken by the advancing shock. Consideration is given to this diffusion problem, governed by the particle flux equations and Poisson's equation for the self-consistent electric field, in the limiting situation when a dimensionless photoionization rate (alpha) and dimensionless shock speed (v sub s) are large, and the ratio of ion to electron diffusion coefficients (delta) is small. The alpha and v sub s limits

separate the region of production by photoionization from regions of electron diffusion from regions of ion diffusion.
Author (USGRDR)

N68-36612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF VISCOUS-FLUID JETS
L. A. Vulis and V. Kashkarov 19 Dec. 1967 537 p refs Transl. into ENGLISH of the book "Teoriya Struy Vyazkoi Zhidkosti" Moscow, 1965 p 1-431
(FTD-HT-23-669-67; AD-673687)

The book is devoted to the results of investigations of a broad and widespread category of incompressible fluid motions in the form of laminar and turbulent jets. The development of computational methods applicable to an important type of jet streams and based on a consistent and systematic study of jet flows with a theoretical approach is the aim of the monograph. There are four parts to the book, including a foreword and an introduction. The first part deals with the solutions of jet problems based on the exact Navier-Stokes equations for incompressible fluids and, in particular, with the Landau investigation of the propagation of a submerged axially symmetric viscous fluid jet issuing from a thin tube. The second part contains a detailed analysis of laminar jet streams of an incompressible fluid by methods of boundary layer theory. In addition to free jets flowing into a stationary medium or into homogeneous wake flows, semibounded jets (wall jets) are considered. Turbulent jets of liquids and gases are the subjects of the third part, in which self-similar solutions for free and wall jet sources are investigated. It also contains detailed experimental data obtained under the guidance of one of the authors in thermophysical laboratories in Alma Ata for comparison with the theoretical results. The fourth part deals with certain theoretical and experimental problems of jet streams which may be regarded as complementary to the main topics treated in this book. Among them are complex turbulent jet streams, patterns of diffusion flames, and jets in magnetohydrodynamics.
Author (TAB)

N68-36627# Oak Ridge National Lab., Tenn.
HYDROMAGNETIC GOERTLER INSTABILITY IN A BOUNDARY LAYER ON A CONCAVE WALL
T. S. Chang and W. K. Sartory [1967] 17 p refs Presented at the 4th Southeastern Conf. on Theoretical and Appl. Mech., New Orleans, La.
(Contract W-7405-ENG-26)
(ORNL-P-3297; CONF-680201-2) CFSTI: HC $3.00/MF $0.65

The effect of an applied magnetic field on the Görtler instability of a Blasius boundary-layer flow over a concave wall is investigated analytically for the case where the fluid is a finite electrical conductor and the wall is perfectly conducting. The magnetic field, which is aligned parallel to the wall and perpendicular to the flow direction, is found to have a stabilizing effect just as with Taylor instability considered by earlier investigators. The effect on stability of the component of velocity normal to the wall in growing boundary layer is also considered by making calculations both with and without the normal flow terms. The normal flow is found to have a destabilizing effect, especially with small values of the Hartmann modulus. At large values of the Hartmann modulus, the normal flow appears to suppress the formation of oscillatory modes of instability.
Author (NSA)

N68-36629 California Univ., Los Angeles.
EXPERIMENTAL INVESTIGATION OF ELECTRON RUNAWAY PHENOMENA
John Stacy De Groot (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-211

An experiment is reported in which the dynamic response of a gaseous plasma to the sudden application of a strong electric field is measured. The plasma is produced by photoionization of xenon gas. The photons are generated over a period of about 3.5 microseconds by a vacuum spark driven by a 500 joule capacitor bank. The initial fractional ionization is about 1 percent in xenon. Langmuir probes were used to measure the plasma properties. The experimental results indicate that: if the electric field is much larger than the runaway value, the electrons are freely accelerated, unimpeded by collisions with the ions. Density and potential fluctuations are found to be spontaneously generated in the plasma. These waves grow in time, evidently stopping electron runaway. The electron drift velocity reaches a peak value and then decreases. The experimental values of the time dependent electron drift velocity compare favorably with those of the theory. The long-time behavior of the current is controlled by electron-neutral collisions.
Dissert. Abstr.

N68-36669# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES, CHALICE Annual Report, 1966-1967
George J. Yevick [1967] 170 p refs
(Contract AT(30-1)-2582)
(SIT-2582-25) CFSTI: HC $3.00/MF $0.65

Research developments during this period are reported: (1) experimental results and their interpretation, (2) plasma dynamics, (3) Mach-Zehnder interferometer, (4) bremsstrahlung, (5) fast scintillator, (6) low temperature measurement, (7) preheater, (8) θ-pinch bank, (9) cusp bank, (10) plasma chamber, (11) coil design, (12) snow plow model shock front for fast pinches, and (13) direct correlation function in space and time.
NSA

N68-36689*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
STABILITY OF A PURE ELECTRON PLASMA IN CYLINDRICAL GEOMETRY Progress Report
Georg Knorr Aug. 1968 27 p refs
(Grant NGR-16-001-043; Contract Nonr-1509(06))
(NASA-CR-97189; Rept.-68-43) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The stability of a cylindrical cold plasma consisting of electrons only is investigated analytically. The geometry is similar to that of the proposed heavy ion plasma accelerator. The dispersion equation is derived and discussed for the case that the plasma rotates like a rigid body. The resulting instabilities are found to be much more violent than those studied by Buneman et al. for a straight geometry. The underlying physics is discussed.
Author

N68-36718# Stevens Inst. of Tech., Hoboken, N. J.
HISTORICAL SURVEY OF PROJECT CHALICE. EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES, CHALICE
George J. Yevick [1967] 34 p refs
(Contract AT(30-1)-2582)
(SIT-2582-26) CFSTI: HC $3.00/MF $0.65

Review type discussions are presented on the following: (1) original Chalice proposal, (2) present scheme of Chalice, (3) ring Chalice, (4) development of project Chalice, (5) unsolved problems, (6) theoretical work, and (7) future work.
NSA

N68-36740# Technische Hochschule Munchen (West Germany).
STAGNATION POINT FLOW IN MAGNETOGASDYNAMICS [BEITRAEGE ZUR MAGNETOGASDYNAMISCHEN STAUPUNKTSTROEMUNG]
Eduard Bernhard Igenbergs (Ph.D. Thesis) [1967] 358 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

The behavior of a one-dimensional relaxation zone with magnetic field effects behind a vertical compression shock in air

is represented by a system of differential equations. Numerical integration indicates an interchange effect between relaxation flow and magnetic field. Sample calculations for two flow conditions show a difference in the coupling between the chemical reactions in the flow and the magnetic field. The magnetogasdynamic stagnation point flow was examined with and without friction effects. The computer printouts and a 102-title bibliography are included. Transl. by K.W.

N68-36768# Electro-Optical Systems, Inc., Pasadena, Calif.
A STUDY OF INTERACTIONS BETWEEN ELECTRIC ARCS AND GAS FLOWS Final Report, Apr. 1965–Apr. 1967
G. L. Marlotte, G. L. Cann, and R. L. Harder Mar. 1968 145 p refs
(Contract AF 33(615)-2711)
(EOS-6934-F; ARL-68-0049; AD-673368)

The report covers experimental and theoretical investigations of the interactions between an arc and a gas flow in a constrictor. The effects of vortex injections were analyzed and measured. Stability criteria were developed for the radiation dominated arc. Several distinct modes of operation were observed, and their operating characteristics were tentatively determined. The introduction of gas dynamic and/or magnetohydrodynamic turbulence to reduce radiation was identified as an important ingredient in high enthalpy heaters. An analysis of the radiation dominated arc correlates the nitrogen data well. Author (TAB)

N68-36782# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
INVESTIGATION INTO THE FILLING OF A TOROIDAL MAGNETIC CONFIGURATION BY THE INJECTION OF FAST NEUTRALS [ETUDE DU REMPLISSAGE D'UNE CONFIGURATION MAGNETIQUE TOROIDALE PAR INJECTION DE NEUTRES RAPIDES]
M. Fumelli, J. P. Girard, and C. Gourdon Livermore, Calif. Calif. Univ. Lawrence Radiation Lab. [1968] 49 p refs Transl. into ENGLISH from the Rept. EUR-CEA-FC-432
(UCRL-TRANS-10223) CFSTI: HC $3.00/MF $0.65

The investigation shows the possibility of forming in a toroidal configuration a plasma of density greater than $10^{12}cm^{-3}$ and of a high temperature (greater than 500 eV for the special conditions of the calculation). It is further shown that if fast neutrals are injected into a pre-established plasma, one can obtain in less than 1 second a density greater than $10^{12}cm^{-3}$ and a temperature of 40 eV, and this with a diffusion time only 100 times greater than the Bohm diffusion time. NSA

N68-36799# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INFLUENCE OF HALL CURRENTS DURING ACCELERATION OF A CONDUCTING GAS IN ITS INTRINSIC MAGNETIC FIELD [O VLIYANII TOKOV KHOLLA PRI USKORENII PROVODYASHCHEGO GAZA V SOBSTVENNOM MAGNITNOM POLE]
G. M. Bam-Zelikovich 4 Oct. 1967 14 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1965 p 27–34
(FTD-HT-67-458; AD-673804)

The effect of Hall currents in the magnetic fields induced by the currents flowing in the plasma is studied theoretically in regard to their relation to plasma acceleration mechanisms. Magnetohydrodynamic equations and a generalized Ohms law are used to obtain the solution for the flow distribution in a plasma subject to the existence of large velocities (10 to the 7th power cm/sec) so that pressure gradients can be neglected. It is assumed that no external magnetic fields and no electric fields along the length of the channel exist in the flow. The conductivity is assumed to remain constant and the product of cyclotron and collision frequencies, k, is constant. The solution is obtained by expressing the dependent variables in powers of k and all k sq and higher power terms are neglected. The system of equations for the first order quantities is solved by quadratures for known zero order values. The flow distribution is examined in greater detail in the core of the flow and the solution for some initial and boundary conditions is given. A comparison with a previous study shows that the effect of the Hall currents is similar to that for the case with an external magnetic field. Small asymmetry relative to the axis of the channel develops when only a self-induced magnetic field is present. Author (TAB)

N68-36918# California Univ., Livermore. Lawrence Radiation Lab.
PRELIMINARY INVESTIGATION OF THE PROPERTIES OF A SCALED UP ASTRON
N. C. Christofilos 30 Oct. 1967 21 p refs
(Contract W-7405-eng-48)
(UCID-15241) CFSTI: HC $3.00/MF $0.65

The magnetic field pattern of a thick E layer and Bohm confinement time in this pattern are described. Plasma scaling laws, selection of the momentum of the E-layer particles for optimum plasma parameters, and calculations of the tolerable confinement time in comparison to Bohm confinement time are discussed. NSA

N68-36922# California Univ., Berkeley. Electronics Research Lab.
EXPERIMENT ON STABLE AND UNSTABLE FLUTE OSCILLATIONS IN A SCALED DOWN MIRROR MACHINE
T. Y. Chang 24 May 1967 36 p refs
(Contract AT(11-1)-34)
(ERL-M-213) CFSTI: HC $3.00/MF $0.65

The behavior of flute modes in a mirror machine was studied in a scaled experiment using a potassium plasma generated by surface emission from a centrally located ionizer cathode. The scaling concept and its general application are discussed. Preliminary results of the experiment are also presented. It is found that the plasma is quite reproducible and can be partially expanded away from the ionizer cathode by magnetic decompression. Various flute oscillations were observed and their mode numbers and phase velocities carefully determined. Further improvements in the measurement of both the electric field and the flute growth (or transport) rate are necessary. Author (NSA)

N68-36934# Academy of Sciences (USSR), Moscow.
SOME ELECTRICAL PROPERTIES OF DENSE PLASMA
V. A. Alexeev [1968] 9 p refs Transl. into ENGLISH from Russian Rept. SM-107/129 Presented at the Symp. on Magnetohydrodynamic Elec. Power Generation, Warsaw, 24–30 Jul. 1968
(CONF-680704-2)

The considerable interest which appeared during the latest years concerning dense plasma, is in the first place caused by the possibility to produce a working media with high conductivity for MHD conversion and an aspiration to more profound understanding of the nature of conduction in the condensed state of matter. A peculiarity of such plasmas is the presence of quantum effects, caused by the overlapping of electron wave functions. Author (NSA)

N68-36937# European Space Research Inst., Frascati (Italy).
DRIFT WAVES IN THE LABORATORY AND IN THE IONOSPHERE
N. D'Angelo Paris ESRO Jan. 1968 11 p refs
(ESRO-SN-82(ESRIN)) CFSTI: HC $3.00/MF $0.65

An account is given of some experiments performed a few years ago with a plasma device, containing either caesium or potassium ions, situated in a uniform magnetic field. The resulting density perturbations in the plasma, in the range 5–30 kc/s, were divided into four modes. These observations are interpreted in terms of a 'drift' wave model which is then used in an attempt to interpret some auroral forms and the 'travelling irregularities' observed at the lower edge of the equatorial E layer. Some suggestions are made for overcoming the remaining difficulties. Author (ESRO)

N68-36998# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF A DECAYING HELIUM PLASMA HAVING A HIGH NEUTRAL PARTICLE DENSITY [ETUDE D'UN PLASMA D'HELIUM A FORTE DENSITE DE NEUTRES EN REGIME DE RELAXATION]

Robert Deloche Mar. 1968 31 p refs In FRENCH
(CEA-R-3450)

The effect of low-energy inelastic collisions between neutral particles on the population densities of excited molecules and the electron–ion recombination coefficient was investigated in a high-pressure decaying He plasma. The formalism of Bates (1962) was used, taking into account simultaneously collisional mechanisms with electrons, collisional mechanisms with neutrals and radiative processes. The variation of the population densities and electron–ion recombination coefficient with respect to the pressure is given for different values of electron density and temperature. These theoretical results indicate an effect of pressure large enough to be measured and allow one to define the most favorable experimental conditions. Author (NSA)

N68-37006# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.

ANOMALOUS HIGH-FREQUENCY CONDUCTIVITY OF A TURBULENT PLASMA

B. Bertotti and O. De Barbieri Mar. 1968 42 p refs Sponsored in part by EURATOM
(LGI-68-11) CFSTI: HC$3.00/MF$0.65

The anomalous high-frequency conductivity arising from particle-wave interactions in a many species turbulent plasma with no external magnetic field was evaluated for a wide range of frequencies embracing the electron plasma frequency. It was found that the conductivity tensor was anisotropic and slowly time dependent, and that there was a very narrow range of frequencies (just above the electron plasma frequency) for which its components were negative. The particular case of the two-stream instability was examined in detail and the anisotropic character of the components of the conductivity tensor and their dependence on the frequency of the external field were studied. Some possible experimental checks of the calculations are suggested. Author (ESRO)

N68-37015# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

DISPLACEMENT OF IONIZATION IN A PLASMA DUE TO PARTICLE CURRENTS IN THE DIRECTION OF A TEMPERATURE GRADIENT [UEBER DIE VERSCHLEPPUNG DER IONISATION IM PLASMA DURCH TEILCHENSTROEME IN RICHTUNG EINES TEMPERATURGRADIENTEN]

K. Bergstedt Dec. 1967 56 p refs In GERMAN; ENGLISH summary
(IPP-3/64) CFSTI: HC$3.00/MF$0.65

A magnetically stabilized quasi-stationary He plasma with large temperature gradients is taken as an example to measure the ionization of He^2 as a function of the radius. The radial profiles of electron temperature and density are also determined experimentally. These experimental values are used to calculate the partial pressures of the plasma components and the total pressure as a function of the radius. Evaluation of the momentum balance of the plasma components enables both a radial center-of-mass velocity of the plasma and the ion current due to the ambipolar diffusion of the He ions to be determined. It is found that the latter is mainly responsible for displacing the He II ionization. By graph integration of the local balance equation for doubly charged He ions, it is possible to obtain independently a second method of determining the ion current. The values obtained by the two methods for the ion current, which is responsible for displacing the ionization, are in agreement. Discussion of the continuity equation for all He particles, moreover, allows the displacement of the He I ionization by ambipolar diffusion and plasma flow to be estimated. It is found that the neutral particle density decreases much more slowly with rising temperature than is the case in static ionization, this being consistent with other observations. Author (ESRO)

N68-37034# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.

MEASUREMENT OF THE ELECTRON DENSITY OF A PLASMA BY INTERFEROMETRY WITH A He-Ne LASER ($\lambda = 3.39\,\mu$) [MESURE DE LA DENSITE ELECTRONI QUE D'UN PLASMA PAR INTERFEROMETRIE AVEC UN LASER He-Ne ($\lambda = 3.39\,\mu$)]

Pierre Belland Feb. 1968 74 p refs In FRENCH; ENGLISH summary
(CEA-R-3461) CFSTI: HC$3.00/MF$0.65

The characteristics of the He-Ne gas laser used in a simple interferometric technique have been studied. After passing through the plasma, the beam is reflected back into the laser cavity, and the intensity of the laser itself, modulated by this optical feedback, is used to observe the fringes. Furthermore, owing to the coupling of the two laser transitions 0.63μ (red) and 3.39μ (infrared), interferences in the infrared can be detected by a simple photomultiplier monitoring the red line. This method has been applied to two plasma machines (E.P.P.E. and Sablier) for spatial and temporal measurements of the mean electron density. Author (ESRO)

N68-37045# Stichting Voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Inst. voor Plasma-Fysica.

TOROIDAL SCREW PINCH

C. Bobeldijk May 1968 62 p refs
(NP-17527)

Experiments and theory are described on the screw pinch, a toroidal plasma column produced and confined by a helical magnetic field. The properties of the plasma, the distribution of the magnetic field, and the position of the column were determined. All signals are highly reproducible, even if the pitch of the magnetic field is varied between wide limits. Existing magnetohydrodynamic stability theories predict instability for a plasma column in vacuum in this configuration. As a result of this investigation, it appears that these theories are not applicable to the screw pinch, since it is not surrounded by vacuum, but by a pressureless plasma with low density and high conductivity. As a result of the way in which the screw pinch is formed, currents run in this outside region which cause the pitch of the magnetic field to be homogeneous and constant. This has important consequences for equilibrium and stability. Author (NSA)

N68-37052*# Stanford Univ., Calif. Aeronautics and Astronautics Dept.

INTERFEROMETRIC STUDY OF THE NONEQUILIBRIUM SHOCK REFLECTION PROCESS AND THERMAL LAYER IN IONIZING ARGON

Ralph A. Kuiper Aug. 1968 144 p refs
(Grant NGR-05-020-091)
(NASA-CR-97252; SUDAAR-353) CFSTI: HC $3.00/MF $0.65
CSCL 20I

Two wavelength, time resolved interferograms provide time history measurements of the thermodynamic properties behind the reflected shock wave in ionizing argon and an informative flow visualization of the shock reflection process, including the nonequilibrium wave interactions resulting from the onset of ionization behind both the incident and reflected shocks. Argon ionization relaxation times obtained from the interferograms are correlated and compared with previous measurements over a range of shock speeds from 2.9 to 5.5 km/sec. Density and electron concentration profiles are obtained in the ionized, end wall boundary layer from the interferograms. Upon comparison, it is found that the experimental electron concentrations remain considerably higher in the boundary layer than predicted by theory. The discrepancy is attributed primarily to nonequilibrium effects which are not accounted for in the theoretical treatment. From a comparison of theory and preliminary boundary layer experiments when no ionization is present, a value of $\nu = .75$ for the temperature exponent is obtained when the thermal conductivity for neutral argon is assumed proportional to T^{ν}. Author

N68-37062# European Space Research Inst., Frascati (Italy).
LANDAU DAMPING OF LONG WAVELENGTH ION ACOUSTIC WAVES IN A COLLISION-FREE PLASMA WITH A GRAVITY FIELD
D. Parkinson and K. Schindler [1968] 16 p refs Submitted for publication
CFSTI: HC$3.00/MF$0.65

Ion acoustic waves propagating in a collision-free, gravity-supported one-dimensional plasma are studied, including conditions where the wavelength is of the order of the scale height of the equilibrium plasma. It turns out that the fluid dynamic steepening tendency of waves propagating in the direction of decreasing density is overcome by Landau damping up to wavelengths of the order of the scale height or even larger, depending on the ratio of the electron and the ion temperatures. ESRO

N68-37078# Princeton Univ., N. J. Plasma Physics Lab.
ON THE KINETIC THEORY OF STABLE AND WEAKLY UNSTABLE PLASMA, PART 2
A. Rogister and C. Oberman [1968] 72 p refs Sponsored in part by ESRO Submitted for publication
(Contract AT(30-1)-1238)
CFSTI: HC$3.00/MF$0.65

The foundations of an enlarged kinetic theory of plasma is given, the time evolution of the electric field fluctuations being considered simultaneously with the time evolution of the one-particle distribution F. The theory is then further improved by including systematically all processes which are relevant in plasma if one excludes strong turbulences. The equation for the waves now include the effect of collisional damping and nonlinear Landau damping, as well as the description of the emission processes of plasma waves. The calculation of the rate of decay of the waves also yields the general expression of the electrical conductivity of plasma, including the effect of the scattering of electrons by waves. It has also been shown that the Markoffian behavior of plasma in the space $[J_k, F]$ is preserved to higher order in the expansion if one excludes strong turbulences. ESRO

N68-37106# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.
INVESTIGATION OF TURBULENT PLASMAS BY LIGHT SCATTERING
F. De Marco and L. Pieroni May 1968 35 p refs Sponsored in part by EURATOM
(LGI-68-15) CFSTI: HC$3.00/MF$0.65

The physical quantities characterizing plasma turbulence and the practical measurement of them are outlined. The problem of turbulence is examined in the context of the general statistical and kinetic theory of many body systems and a laser light scattering experiment for the examination of plasma characteristics (turbulence and micro-instabilities) is discussed. The scattering cross-section is derived by a quantum mechanical treatment and some scattering experiments, especially in hot plasmas, are proposed. ESRO

N68-37158# Princeton Univ., N. J. Plasma Physics Lab.
CLOSED MAGNETIC TRAP WITH A HELICAL FIELD "SIRIUS"
O. V. Biryukov, P. Ya. Burchenko, V. T. Vasilenko, E. D. Volkov, A. V. Georgievskii et al Dec. 1967 19 p refs Transl. into ENGLISH from RUSSIAN report
(Contract AT(30-1)-1238)
(MATT-TRANS-45) CFSTI: HC$3.00/MF$0.65

A brief description of the Sirius stellarator is given. The characteristics of the individual units of the trap and the arrangement used in generating and heating the plasma are given. NSA

N68-37171# Princeton Univ., N. J. Plasma Physics Lab.
PULSED THERMONUCLEAR SYSTEM WITH A DENSE PLASMA
S. G. Alikhanov, G. N. Kichigin, and I. K. Konkashbaev Feb. 1968 19 p refs Transl. into ENGLISH from Russian report
(Contract AT(30-1)-1238)
(MATT-TRANS-50) CFSTI: HC$3.00/MF$0.65

An investigation was made of a closed system which is convenient for adiabatic compression of a dense plasma by jacket deformation. It is shown that the system is in equilibrium and magnetohydrodynamically stable for the required time. A sufficient rate of compression and the brief period of operation of the system offer the possibility of neglecting the relatively slow losses of plasma as a result of diffusion with a Böhm order coefficient. Author (NSA)

N68-37184# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
OPTICALLY STIMULATED PLASMA EFFECT ON ALUMINUM IN ULTRAHIGH VACUUM [OPTISCH ANGEREGTE PLASMAEFFEKTE AN ALUMINIUM IM ULTRAHOCHVAKUUM]
Berndt Feuerbacher May 1968 44 p refs In GERMAN; ENGLISH summary
(DESY-68/27)

The optically excited plasma resonance in Al was studied under uhv conditions in reflection and photoemission, using synchrotron radiation as the light source. Measurements were made between 500 and 1100 Å at various angles of incidence in both s and p polarization on freshly evaporated Al films at pressures of about 10^{-9} torr. A pronounced maximum in reflectivity and photoelectric yield in p polarization was found near the plasma frequency, which is the result of the plasma resonance. In the reflection spectrum a Brewster minimum is also found. Both structures are missing in s polarization. The influence of surface layers was studied by stepwise venting the system with air and oxygen. The reflectometer developed for the measurements is described. Author (NSA)

N68-37237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF ELECTROMAGNETIC WAVES ON A DIELECTRIC ROD IMMERSED IN A PLASMA INCLUDING A DISCUSSION OF DIAGNOSTIC APPLICATIONS

David L. Wright and Norman C. Wenger. Washington Oct. 1968 31 p refs
(NASA-TN-D-4866) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The guided electromagnetic waves that propagate along a lossless dielectric rod immersed in isotropic and uniaxial plasmas are determined. For the uniaxial plasma, only the case where the optic axis is alined parallel to the dielectric rod is considered. Both plasmas are described by the linearized momentum transport equation for a cold, collisionless, electron fluid of uniform density. Numerical results for the propagation constants of the waves are presented as a function of the rod and plasma parameters for both the circularly symmetric and dipole modes. Important aspects of the results are discussed with particular emphasis on plasma diagnostic applications. Author

N68-37324# United Aircraft Corp., East Hartford, Conn. Research Labs.
PRODUCTION OF PLASMAS FOR THERMONUCLEAR RESEARCH BY LASER BEAM IRRADIATION OF SOLID PARTICLES Semiannual Report, Feb. 1–Jul. 31, 1968
Alan F. Haught, Donald H. Polk, and Walter J. Fader 31 Jul. 1968 41 p refs
(Contract AT(30-1)-3578)
(UARL-G-920365-9; NYO-3578-9) CFSTI: HC $3.00/MF $0.65

Production of high-temperature, high-density, spherically expanding free plasmas and the interaction of these plasmas with magnetic containment fields of mirror, cusp, and minimum-B geometry are being investigated experimentally and theoretically. The plasmas are produced by focused laser beam irradiation of a single micron-sized solid particle of lithium hydride which is electrically suspended in vacuum at the focus of a lens. Theoretical studies of the early plasma-magnetic field interaction, using the hydrodynamic model, have shown that the initial plasma formation and development is unaffected by the presence of magnetic fields of $\leq$ 10 kG field intensity. Studies of the interaction of these initially spherical, expanding plasmas with magnetic confinement fields of mirror and minimum-B geometry at field strengths up to 8 kG show that the plasma is contained at densities $> 10^{13}/cm^3$ for as long as 10 μsec (minimum-B), and that the major plasma loss is through the mirror loss cones. Author (NSA)

N68-37375# Miami Univ., Coral Gables, Fla. Dept. of Physics.
VARIATIONAL APPROACH TO THE DYNAMIC STABILITY OF HIGH DENSITY PLASMAS IN MAGNETIC CONTAINMENT DEVICES
Daniel R. Wells and Joseph Norwood, Jr. [1967] 43 p refs
(MIAPH-PL-67.10) CFSTI: HC $3.00/MF $0.65

Variational methods are used to determine the structure of dynamically stable plasmoids. The total energy of the plasmoids is varied subject to a set of constraint integrals on the flow. It is demonstrated that the results in a plasmoid of the type observed experimentally when the angular momentum of the plasmoid is not conserved. This is the colinear vortex structure. Experimental results are presented which demonstrate that the structures observed in mirror-tapping experiments are of the type predicted by the variational calculation. Results are presented which illustrate these effects and show details of the structures. It is demonstrated that a modification of these solutions that assumes conservation of angular momentum of the plasmoid describes another plasma structure which is centered on the magnetic field lines and moves at right angles to the field. Author (NSA)

N68-37410*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 116–135 refs (See N68-37397 23-11)

Reported are research and advanced concepts related to the following: (1) laminarization in nozzle flow; (2) liquid-metal MHD (magnetohydrodynamic) power conversion; (3) the SE-20C thruster design; (4) radial distribution of enthalpy in a high temperature swirling flow; (5) effects of an applied, transverse magnetic field on heat transfer with swirling and nonswirling gas flow; and (6) effects of an applied, transverse magnetic field on wall pressure in a square channel. S.C.W.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-36010 Cornell Univ., Ithaca, N. Y.
PHYSICAL PROCESSES IN ELECTRICAL BREAKDOWN IN VACUUM
Takao Utsumi (Ph.D. Thesis) 1967 155 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-3796

An experimental and theoretical analysis of physical processes in electrical breakdown in high vacuum is presented. The main topics considered are whether the breakdown which occurs between two parallel-plane electrodes in a vacuum is a cathode induced or anode induced breakdown and what conditions determine which type is dominant. The critical anode power density was measured as a function of the bombarded area by means of magnetically controlled anode breakdown. The critical cathode current density was measured as a function of height of the whiskers. The height and the emitting area of the whisker were estimated by measuring the spreading of the field-emitted electron beam coming from the whisker itself. The experimental results obtained are consistent with the values calculated from the theory of heat conduction not only in magnitude but also in functional dependence. Dissert. Abstr.

N68-36022 Stanford Univ., Calif.
WAVE PROPAGATION AND INSTABILITIES IN SEMICONDUCTORS
Pierre Leopold Gueret (Ph.D. Thesis) 1967 221 p
Available from Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 67-17429

This study is concerned with the problem of wave propagation and instability in collision-dominated media, particularly semiconductors and semimetals, in the presence of external electric and magnetic fields. The major part of the work is based on a macroscopic description of carrier motion (continuity and momentum equations). After a discussion of the validity of the approach used, the general interest is mainly centered on a type of slow wave called carrier wave (because it has a phase velocity equal to the carrier drift velocity). It is shown that, in some circumstances, carrier waves can have very low loss or can even grow. They may therefore have practical applications in delay lines or active devices. Besides the possible device applications, this study was also aimed at finding an explanation for the noise emission from indium antimonide in the presence of external electric and magnetic fields. A theory is presented which is in good agreement with some of the available experimental data. Dissert. Abstr.

N68-36030 Washington Univ., Seattle.
HYPERSONIC ATTENUATION IN SUPERCONDUCTING MERCURY
Richard Bert Ferguson (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17182

The attenuation of longitudinal acoustic waves in polycrystalline mercury was measured in the normal and superconducting states

between 1.5° and 4.2°K at a frequency of 9.2 GHz. The attenuation in the normal state is essentially constant in this range and has a value of about 2000 db/cm. The attenuation in the superconducting region has temperature dependence which can be fit with a single BCS curve characterized by $2\Delta(0)/k_BT_c = 3.9 \pm 0.2$. A pulse echo technique with piezoelectric generation and detection by means of a quartz rod in a microwave cavity was used. A novel technique for fabricating suitable sample which should be applicable for other metals with low melting points is described. A recently developed electronic sampling system for signal averaging was also employed. Work in mercury at lower frequencies has shown anomalous absorption similar to that in lead which has been explained to be due to interactions of the ultrasound with dislocations. These interactions are not expected to contribute significantly at 9 GHz, and the present results corroborate this explanation. Dissert. Abstr.

N68-36031 Louisiana State Univ., Baton Rouge.
RADIO-FREQUENCY SIZE EFFECT MEASUREMENTS IN CADMIUM
Ray Christensen Jones (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17322

The Fermi surface cadmium is determined from calipers obtained through radio-frequency size effect measurements. The 6 MHz to 8 MHz *rf* measurements were performed at 1.2°K on high purity monocrystals of cadmium approximately 0.5mm in thickness. These measurements were made by observing the discontinuity in the surface impedance occurring when the carrier orbit diameters span the sample thickness. The Fermi surface was calipered using samples whose normals to the surfaces were parallel to one of the three principle symmetry directions: [0001], [10$\bar{1}$0], and [11$\bar{2}$0] with magnetic field rotations in the plane of the sample. Calipers are assigned to definite orbits on the first and second band hole surfaces and on both sheets of the third band electron surfaces. The third band electron "lens" is found to be smooth and round with a major diameter of 1.560 $Å^{-1}$ and varying less than 1% in the basal plane. The minor diameter has a caliper of 0.556 $Å^{-1}$. A theoretical calculation of the line shapes encountered in the radio-frequency size effect is obtained by solving the Boltzmann equation in conjunction with Maxwell's equations of electrodynamics. The calipers obtained in the experiment are tabulated. Dissert. Abstr.

N68-36032*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DC-BIASED PHOTOCONDUCTIVE DETECTION OF WIDEBAND CARBON DIOXIDE LASER SIGNALS
John H. Mc Elroy Feb. 1968 66 p refs
(NASA-TM-X-63336; X-524-68-54) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The application of dc-biased photoconductive detectors to the reception of wideband CO_2 laser signals is described. Signal-to-noise power ratios in the detection of AM, PM, and FM, by photomixing are derived and the dependence of both signal and noise is shown. Expressions are given for the maximum tolerable mechanical vibration amplitude in a photomixing system and for the beam alignment requirements. Local oscillator power requirements are then discussed and it is shown that no less than 10 mw are required to assure g-r noise limited operation in a typical extrinsic germanium photoconductor. Measurement techniques are then described from which detector quantum efficiency, majority carrier lifetime, and mobility can be determined. Author

N68-36041 Catholic Univ. of America, Washington, D. C.
ELECTRON SPIN-PHONON INTERACTIONS IN SOLIDS DOPED WITH AN S-STATE PARAMAGNETIC ION
Morton Richard Kagan (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17145

Electron spin-phonon interaction measurements were made in sapphire (Al_2O_3) doped with .05% by weight of trivalent iron. An indirect technique was used whereby the electron paramagnetic resonance (EPR) spectra were continuously monitored as the phonon field was applied. These measurements were made at a microwave frequency of 12.15 GHz and with acoustic frequencies in a range of ±30 MHz on either side of this value. The interaction mechanisms were observed only at liquid helium temperatures (4.2°K), and were studied as a function of rf and acoustic power as well as frequency difference between these two sources. Observations were also made as a function of orientation of the external dc magnetic field with respect to the C-axis of the crystal. All results showed a very strong "anti-saturation" effect where the applied phonon fields actually caused an increase in EPR signal. An attempt was made to explain this effect. An expression was derived relating the acoustic transition probability to the spin-lattice relaxation time and EPR signals. A calculation, based on a phenomenological spin-phonon interaction Hamiltonian, is made for S-state ions in trigonal fields. Dissert. Abstr.

N68-36059 Washington Univ., St. Louis, Mo.
NUCLEAR RELAXATION TIMES OF F^{19} IN LaF_3
Louis Ning-Yao Shen (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17198

Measurements are reported of spin-spin relaxation time, T_2, and spin-lattice relaxation time, T_1, of F^{19} in powdered LaF_3 samples containing Pr^{3+} and Nd^{3+} ions. Resonance frequencies of 15.9 and 30.0 Mc/sec were employed and sample temperatures were between 100°K and 800°K. Nominal ion concentrations ranged from 0.1 to 10 atom percent. T_2 is found to be independent of dopant, dopant concentration or the resonance frequency. T_2 is independent of temperature below room temperature. T_2 increases, decreases and then increases again. The T_2 behavior is consistent with the spin-spin relaxation model proposed by Goldman and Shen. From the dependence on temperature, field, dopant and dopant concentration of T_1, the spin-lattice relaxation mechanisms are found to be: (1) The diffusion limited case of spin diffusion to paramagnetic centers. (2) The motion modulated ion-nuclear dipolar interaction. The activation energy associated with the motion is found to be $E_D = 0.29$ eV ± 10%. Dissert. Abstr.

N68-36063 Virginia Univ., Charlottesville.
RESONANCE SCATTERING IN SUPERCONDUCTING ALLOYS
Miguel German Kiwi (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17606

A model is used to investigate the superconducting properties of nonmagnetic alloys of simple metals with transition metal impurities. The alloys are assumed to be very dilute. The resonance scattering effects in the alloys are related to the width Γ of the bound d- state on each impurity, and the physical limit $\Gamma >> kT_c$ is chosen. Here T_c is the superconducting critical temperature of the alloy. The impurity correlations are dependent on the Coulomb interaction U between d- electrons of opposite spin and are included in the superconducting problem by a self-consistent Hamiltonian. The order parameter, the electronic density of states $N(\omega)$, and the specific heat are calculated for the superconducting state of the alloys at temperatures T such that $0 \leq T << T_c$. It is found that $N(\omega) \approx (\omega-\omega_G)^{1/2}$ close to the gap edge ω_G and that U has a strong effect on the thermo-dynamic properties of the alloys. The thermodynamic properties are also investigated in the temperature range $0 << T \leq T_c$. It is found that they only depend on the impurity correlations through T_c. However, the transport properties of the alloys are strongly U dependent for these temperatures. The relation to the Kondo effect is discussed. Dissert. Abstr.

N68-36064 California Univ., San Diego.
THE LOW TEMPERATURE MAGNETIC SUSCEPTIBILITIES OF MO(CO), RH(FE), AND IR(FE)
Gordon Stanley Knapp (Ph.D. Thesis) 1967 87 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-808

Susceptability results are presented on various metals with additions of dilute amounts of magnetic materials. The study includes Mo(Fe, Mo(Co), Rh(Fe), and Ir(Fe). All these systems except Mo(Fe) show anomalous temperature dependent susceptibilities and resistivities. Measurements were made on alloys with sufficiently low concentrations of Fe or Co so that magnetic ordering was unimportant. With some degree of success, the measurements can be interpreted on the basis of current theoretical thinking in terms of mutually isolated impurities with modification of their moments due to the conduction electrons. The results on Mo(Co), Rh(Fe), and Ir(Fe are discussed in terms of the Kondo effect. In the case of Mo(Co), qualitative agreement is found with theoreis. For Rh(Fe), Ir(Fe), band structure effects must be considered before satisfactory agreement is found. Dissert. Abstr.

N68-36065 Maryland Univ., College Park.
THE PROXIMITY EFFECT AND ELECTROMAGNETIC RESPONSE OF A CLEAN NORMAL-SUPERCONDUCTING SYSTEM
Albert Jordon Leyendecker (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-522

The effect of the pairing energy of super-conducting electron pairs on the electromagnetic response of a superconductor is discussed. The importance of this energy on the electromagnetic response of any system containing super-conducting pairs is emphasized. A model for calculating the electromagnetic response is chosen consisting of a finite section of normal metal plated on a semi-infinite superconductor. The Gorkov formalism, allowing the complete description of a superconductor, is introduced. A linear approximation is made allowing the solution of the nonlinear Gorkov equations. The probability of finding superconducting pairs in the normal metal for various temperatures and as a function of the normal metal thickness is given. An explicit form is given for the conductivity function as a function of frequency. From this function, the energy important to the electromagnetic response is found to be the pairing energy of superconducting electrons as calculated in the bulk superconductor. The magnetic field response of the superconducting pairs in the normal metal, however, is found to be diminished from bulk response. A method of calculating the second-order corrections to the solutions of the Gorkov equations is developed. It is shown that these corrections to the conductivity are small in the valid region of the theory. Dissert. Abstr.

N68-36066 Minnesota Univ., Minneapolis.
EFFECT OF LOCAL ATOMIC ORDER ON MAGNETIC PROPERTIES OF COPPER-PALLADIUM ALLOYS
Tu Chen (Ph.D. Thesis) 1967 180 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 67-17267

Measurements were made of the local atomic order and magnetic properties on a series of Pd rich Cu–Pd alloys. Measurements were made on alloys in two states: (1) quenched from 950°C, and (2) quenched and subsequently aged two weeks at 300°C. The X-ray diffuse scattering measurements established that the alloys were nearly random for the first atomic shell. Indications are that a small amount of clustering prevails ($\alpha_1 \geq 0$) in the quenched alloys. Aging seems to decrease the amount of clustering. Magnetic measurements of the two atomic order states indicate that the number of holes in the alloy increase with a decrease in clustering; the exchange term is presumed to be responsible for the net decrease in the measured magnetic susceptibilities. Dissert. Abstr.

N68-36082 Missouri Univ., Rolla.
A CALORIMETRIC STUDY OF THE EFFECTS OF SURFACE ENERGY IN A TYPE 2 SUPERCONDUCTOR
Robert Rex Cedric Rice (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16743

A calorimetric study of the effects of the interphase surface free energy has been conducted on ellipsoidal samples of first and second kind superconductors. The measurements were performed using a specially designed magnetization calorimeter by two different techniques. The measurements were made on lead, tin, lead-4at%thallium, and tin-6at% indium. The results confirm the existence and expected sign of the surface energy in a well annealed lead-4at%thallium sample, and indicate that the interphase surface energy in lead and tin is too small to be directly detected by this method. The measured latent heats of transition of lead and tin agree well with the latent heats deduced from the critical field curves. The tin-6at%indium sample was too hysteretic to yield meaningful data. The results of measurements performed on lead-4at%thallium were compared to predictions based on laminar and vortex models of the mixed state. Dissert. Abstr.

N68-36092 Virginia Univ., Charlottesville.
THE RESISTIVITY IN IRON DUE TO ELECTRON-MAGNON SCATTERING
Gerald Reed Taylor, Jr. (Ph.D. Thesis) 1967 171 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17626

The temperature dependence of the resistivity of the flux-closure and partially saturated magnetization states in high-purity <100> and <111> single-crystal iron whiskers has been measured from 4.2°K to 1°K. The presence of only a linear temperature dependent term in the resistivity verifies that the predominant electron scattering process occurring in iron at temperatures below 4.2°K is the scattering of the conduction electrons by spin waves. This linear term describing electron-magnon scattering may result from either electrostatic exchange interactions or spin-orbit interactions between the conduction electrons and the localized, or itinerant, d-electrons; the experimental results are unable to differentiate between these two possible scattering interactions. In either case, however, the experimental results indicate that the electron-magnon scattering is affected by changes in the magnetic state of the iron crystals due to domain changes and the development of a net magnetization. Dissert. Abstr.

N68-36117 Nebraska Univ., Lincoln.
THERMAL DIFFUSE X-RAY SCATTERING AND THE FERMI SURFACE IN ANTIFERROMAGNETIC CHROMIUM
James Michael Costello (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-741

Thermal diffuse x-ray scattering measurements are described which give evidence for the destruction of parts of the paramagnetic Fermi surface of Cr upon transition to the antiferromagnetic state. Relative intensities of scattering from Cr were measured along the [100] direction at 277°K and 329°K, temperatures close to and bracketing the Néel temperature of 315°K. The intensity measured for the paramagnetic state as a function of increasing Q, the reduced wave vector, shows an increase relative to the antiferromagnetic state intensity in the vicinity of 2.90 Q of 3 to 4 percent. Evidence was also found for the corresponding behaviour at 0.90 Q and 1.10 Q. It is shown that this intensity shift between the antiferromagnetic and paramagnetic temperatures is not due to a multiple scattering process involving one-phonon scattering and Bragg scattering. The interpretation in terms of the effect of the antiferromagnetic transition on the Fermi surface and band structure of paramagnetic Cr is then discussed. Dissert. Abstr.

N68-36121 Stanford Univ., Calif.
MICROWAVE PROPAGATION IN PERIODIC FERRITE STRUCTURES
William Francis Egan (Ph.D. Thesis) 1967 317 p
Available from Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 67-17416

A new structure for the propagation of microwave signals has been investigated. It consists of a periodic, linear array of single crystal YIG spheres operating in the uniform mode of precession and coupled together by their external magnetic fields. The concept of a YIG sphere as a microwave resonator is thereby extended to a transmission system consisting of coupled resonators. The array is found to have the properties of a band pass filter whose center frequency and bandwidth are controllable by a dc magnetic field in which the array is immersed. The signal frequency can thus be tracked and characteristics of propagation such as phase constant, attenuation, and group and phase velocities can be controlled electronically at any given frequency. This suggests a number of possible applications such as an electronically variable microwave delay line, an electronically controllable band pass filter, and a wave supporting structure for traveling wave amplifiers and oscillators. Dissert. Abstr.

N68-36125 Stanford Univ., Calif.
PHOTOEMISSION AND OPTICAL STUDIES OF COBALT, PALLADIUM, PLATINUM, AND GADOLINIUM
Albert Yeou-Cherng Yu (Ph.D. Thesis) 1967 202 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-17530

Photoemission and optical reflectivity measurements on cobalt, palladium, platinum, and gadolinium have been made to determine the major features of their electronic structures. The optical density of states of cobalt is found to be very similar to that of nickel and iron, despite the fact that all three metals have different crystal structures. They all have a strong peak at about 5 eV below the fermi level. No such peak is present in the optical densities of states of palladium and platinum at this energy, though the latter has a strong peak at about 7 eV below the fermi level. The optical density of states of palladium and platinum all have strong peaks right below the fermi level, in reasonable agreement with the findings based on specific heat and magnetic susceptibility data. The noble metals, copper, silver, and gold, also have strong peaks near the top of the d states. The optical density of states of gadolinium is found to be in reasonable agreement with the calculated density of states for $-4 \text{ eV} \leq E-E_f \leq 0$. Dissert. Abstr.

N68-36129 Missouri Univ., Columbia.
TEMPERATURE DEPENDENCE OF THE ATOMIC DISPLACEMENTS IN THE POTASSIUM HALIDES
George Timothy Pearman (Ph.D. Thesis) 1967 194 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-323

The displacements of the atoms in a crystalline material from their equilibrium positions due to thermal agitation can be studied by means of X-ray diffraction techniques. This is a report of such a study of the displacements in the potassium halides in the temperature range 90°K to 650°K. By making measurements of the integrated intensity diffracted by several odd and even ordered Bragg reflections, the displacements of both ion types were determined in the materials potassium fluoride, potassium bromide, and potassium iodide. This investigation indicated that the lighter ion in potassium iodide, potassium bromide, and potassium fluoride had the larger displacement at all temperatures between 90°K and 650°K. Also in potassium chloride there was an indication that this was true but it was not possible to establish the individual displacements with enough reliability to be certain. The atomic displacement expressed as a percent of the nearest neighbor distance was found to be nearly the same for all four materials at a given temperature, ranging from around 5% at 90°K to 14-18% at 625°K. Dissert. Abstr

N68-36159# Harry Diamond Labs., Washington, D. C.
ABSORPTION AND FLUORESCENCE SPECTRA AND CRYSTAL FIELD PARAMETERS OF TRIPLY IONIZED TERBIUM IN CALCIUM TUNGSTATE
Donald E. Wortman Feb. 1968 30 p
(HDL-TR-1377; AD-673697)

A study was made of the absorption and fluorescence spectra of Tb(3+) in single crystals of CaWO4 to establish the energy level (7)F ground term of Tb(3+) and determine the crystal field parameters for CaWO4. The crystals were used at temperatures between about 4.2 and 77K where emissions were observed from the (5)D3 and (5)D4 multiplets to the (7)FJ states and where absorption transitions from the ground (7)F6 multiplet to the (7)F0, (7)F1, (7)F2, and (7)F3 multiplets were recorded. The (7)F energy levels were fitted using an effective Hamiltonian for the ground term where the states were described by Russell-Saunders wave functions. This calculation takes into account the complete J-mixing of the states within the ground term by the crystal field and is equivalent to determining the effects of the spin-orbit interaction to second-order. Author (TAB)

N68-36168 Stanford Univ., Calif.
A STUDY OF SUPERCONDUCTIVITY IN ONE DIMENSION USING THE METHOD OF QUANTIZED SOUND WAVES
Michael Schick (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17497

The question whether a system of electrons confined to a ring of negligible thickness exhibits the property of flux quantization characteristic of superconductors is examined using the method of quantized sound waves. It is shown that operators which obey boson commutation relations under certain conditions can be introduced and that the Hamiltonian of the system of fermions, which interact by means of a two particle interaction, can be expressed in terms of these operators. Expressions for the energy and current, valid for the ground state and for finite temperatures are obtained. The total free energy of the system is examined for the existence of relative minima at finite values of the current which would indicate that the system sustains persistent currents and exhibits flux quantization. No such minima are found at finite temperatures in the thermodynamic limit. The conditions under which the method of quantized sound waves is applicable are examined and restrictions on the temperature as well as the range and strength of interaction are obtained. Dissert. Abstr.

N68-36206# Kansas Univ., Lawrence.
DIFFUSION OF VACANCIES AND VACANCY PAIRS IN NaCl
Vaughn C. Nelson and Robert J. Friauf Jun. 1968 4 p refs Presented at the Intern. Symp. on Color Centers in Alkali Halides, Rome
(Contract AT(11-1)-1197)
(COO-1197-30; CONF-680902-2) CFSTI: HC $3.00/MF $0.65

The results reported here indicate that bound vacancy pairs make appreciable contributions to diffusion of both cations and anions. In order to determine defect contributions the following experiments were performed on single crystals of NaCl: (a) the ionic conductivity was measured in the extrinsic and intrinsic ranges (275 to 797°C) with an ac bridge at 1000 Hz; (b) the diffusion of Na was measured (640 to 790°C) with radioactive tracers and the sectioning method; and (c) the drift mobility of Na tracers was measured (600 to 772°C) by applying an electric field during diffusion, and two check points (692°, 773°C) were obtained with Cl tracers. NSA

N68-36220 California Univ., San Diego.
LOW TEMPERATURE ELECTRICAL RESISTIVITY OF PURE NIOBIUM
George Wendell Webb (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-807

The electrical resistance of pure niobium was measured as a function of temperature in the normal state, and as a function of temperature and longitudinal magnetic field in the superconducting state. The high purity of the niobium achieved in this experiment has made possible unambiguous measurements of the intrinsic resistivity at low temperatures. The normal state measurements were carried out in the range from the superconducting transition (T_c = 9.25°K), to 300°K in zero magnetic field and from 2°K to 22°K in a magnetic field sufficient to quench all superconductivity. It is shown that the normal state resistivity closely follows a T^3 law below 60°K. This behavior is discussed in terms of *inter*band versus *intra*band scattering for the conduction electrons in niobium. The results are compared with the temperature dependence of resistivity found for other metallic elements in the periodic system. Dissert. Abstr.

N68-36245 Stanford Univ., Calif.
MICROWAVE MEASUREMENTS OF THE SURFACE IMPEDANCE OF SUPERCONDUCTING TIN AND LEAD
John Paul Turneaure (Ph.D. Thesis) 1967 81 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-17517

The results of two different experiments are reported. In the first experiment, temperature dependent measurements were made of the surface impedance of superconducting tin and lead at 2.85 and 11.2 GHz. These surface impedance measurements were compared with the Mattis and Bardeen theoretical result, including a finite electron-pair coherence length and a finite electron mean free path. In the second experiment, temperature dependent measurements were made of the ac critical magnetic field of superconducting tin at 2.85 GHz. These ac critical magnetic field measurements were compared with dc critical magnetic field measurements. Measurements were made of the unloaded Q and the resonant frequency of microwave cavities. The unloaded Q and resonant frequency were measured by either of two methods: (1) the transient method in which the decay time of the energy in the cavity was measured; or (2) the steady-state method in which the frequency dependence of the power absorbed by the cavity was measured. The surface impedance was then calculated from the unloaded Q and the resonant frequency. Dissert. Abstr.

N68-36247# TRW Systems Group, Washington, D. C. Washington Operations.
TRENDS IN SUPERCONDUCTIVITY RELATED TO ELECTROMAGNETIC SUSPENSION OF HSGT VEHICLES
6 Oct. 1967 46 p refs
(Contract C-353-66)
(TRW-06818-6009-R000; PB-178795) CFSTI: HC $3.00/MF $0.65

The technology of superconductive magnets was studied because of their potential application to electromagnetic suspension of high speed ground transportation vehicles. The technology was observed to be in the classical period of rapid growth which follows a technological breakthrough. The liquid helium technology was also investigated because it is presently the most feasible technique to maintain the low temperatures required for superconductivity. The electromagnetic suspension system which was proposed for HSGT usage was found to be within the present state of the art except possibly for the proposed current density. Author (USGRDR)

N68-36264 Virginia Univ., Charlottesville.
MAGNETORESISTANCE, HALL EFFECT, AND ELECTRON TUNNELING IN IRON FILMS
John Ernest Christopher (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17596

The galvanomagnetic properties of crystalline iron films have been measured at 4.2°K, 77°K and 300°K in magnetic fields of up to 50KOe. The films were mostly of (100) – (100) orientation, had residual resistivity ratios of from 20 to 55 and ranged in thickness from 0.1μ to 3μ. The low field magnetoresistance is interpreted in terms of domain structure changes. The magnetoresistance in each domain and the high field magnetoresistance are interpreted in terms of the internal field and for long relaxation times the usual Lorentz force magnetoresistance. For short relaxation times some other effect is dominant. The Hall effect is interpreted in terms of $V_H = I/T\ (R_0B + R_s 4\pi M)$. R_0 is negative at 4.2°K. With reference to the spin orbit coupling theories of the ferromagnetic Hall effect, the values of R_s at 4.2°K, 77°K and 300°K do not fit a single term power law in the resistivity. Also reported are tunneling resistance measurements on aluminum–aluminum oxide–iron junctions. Dissert. Abstr.

N68-36280 Florida State Univ., Tallahassee.
STRUCTURAL CHANGES AND SURFACE KINETICS OF VACUUM DEPOSITED DISCONTINUOUS GOLD FILMS
William Baars Phillips (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-372

Gold films having average thicknesses between 10 and 40 Å were evaporated in high vacuum onto either amorphous carbon or silicon monoxide substrates, heated to temperatures between 500 and 750°K. Series of films evaporated simultaneously were cooled to room temperature, while still in vacuum, at different time intervals after deposition had ceased. These intervals ranged from 50 to 300 minutes. Analysis of the electron photomicrographs made of these films revealed that the nuclei, or islands, were nearly circular and had a double peaked size distribution which was not predicted by any existing nucleation theory. Structural changes were observed to have occurred during the period after deposition had ceased but while the films were kept heated. Evidence was presented from the photomicrographs that island movement on the substrate had occurred. A model, based on thermally induced island motion, was developed in which it was assumed that the islands were contained in two dimensional potential wells. Dissert. Abstr.

N68-36283# Gulf General Atomic, San Diego, Calif.
STUDIES IN ZINC OXIDE PHOTOCONDUCTIVITY Final Technical Report
Howard Saltsburg Aug. 1968 46 p refs
(Contract DAAK02-67-C-0115)
(GA-8431; AD-673836)

A study of the gas evolved (or adsorbed) from an electrophotographic ZnO (ZZZ-661), a spectroscopically pure ZnO (SP-500), and a commercial Electrofax paper when irridiated by ultraviolet (UV) has been carried out using gas chromatographic techniques. Some studies of the photoconductivity of ZnO were also carried out using ac conductivity techniques. On the ZnO samples studied, O2 desorption was never obeserved, but only adsorption. Further, on ZnO ZZZ-661, in addition to O2 adsorption, CO2 was produced. No CO2 was observed on either the SP-500 or the paper samples. The origin of the CO2 appears to be a carboneceous impurity, probably present in the ZZZ-661 as a carbon-oxygen complex. The electrical conductivity studies were not readily interpretable because they did not conform to the simple Debye model involving bulk and surface regions of differing conductivity. Actual printing experiments showed that, as found by others, O2 was necessary to cause charging. Ozone was not effective in charging the electrophotographic paper for printing. Author (TAB)

N68-36356# Library of Congress, Washington, D. C. Aerospace Technology Div.
BINARY AND TERNARY GALLIUM AND INDIUM CHALCOGENIDE SYSTEMS. PART 3: TERNARY SYSTEMS WITH A 1-, 2-, 3-, or 5-GROUP ELEMENT
John Kourilo *In its* Foreign Sci. Bull. Sep. 1968 p 39–52 refs (See N68-36352 23-23)

Current trends and achievements of Soviet and East European research are discussed in relation to the Soviet theory of crystallochemical analogy and isoelectronic series of inorganic complex phase semiconductor materials. The studies are singled out of the phase diagrams, crystal structure, and optical and electrical properties of the homogeneous semiconducting ternary solid solutions and compounds to reveal the nature of the chemical bond and the energy band structure of the materials within the ternary systems. Phases with a relatively wide forbidden energy gap, or practically interesting photoluminescent and photoconducting properties were detected and described in the ternary systems studied. The $AgGaTe_2$ and $AgInTe_2$ compound semiconductors with a normal tetrahedral lattice were cited as prospective materials for IR image translators. Author

N68-36358 Cornell Univ., Ithaca, N. Y.
ELECTRON HOPPING TRANSPORT IN $Na(0.33)V_2O_5$
Jerome Howard Perlstein (Ph.D. Thesis) 1967 125 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-673

The temperature dependence of the Hall effect, Seebeck coefficient and electrical conductivity was determined on single crystals of sodium vanadium bronze, $Na_xV_2O_5$, for $x = 0.33$. The absence of a positive Knight shift of the Li^7 NMR in $Li_{0.33}V_2O_5$, together with a Curie–Weiss dependence of the magnetic susceptibility for $Na_xV_2O_5$, $0.24 < x < 0.34$, indicated that each electron per sodium atom was localized on a vanadium site. The magnetic susceptibility results showed no variation of the Weiss constant with sodium concentration and no antiferromagnetic transition temperature from 1°K to 300°K. The experimental magnetic moment goes to zero at 0°K. Hall coefficients indicate a constant conduction electron density from 189°K to 300°K with values close to the sodium atom concentration of 3.8×10^{21}/cc. Hall mobilities varied from 0.09 cm^2/v-sec at 189°K to 0.18 cm^2/v-sec at 298°K. Measurement of the Seebeck coefficient, S, varies from $-222\ \mu v/°K$ at 77°K to $-135\ \mu v/°K$ at 140°K and then remains essentially constant up to 300°K. The electrical conductivity from 77°K to 300°K shows an exponential temperature dependence with a positive temperature coefficient. Dissert. Abstr.

N68-36419 Stanford Univ., Calif.
ELECTRON-INDUCED CASCADE SHOWERS IN COPPER, TIN, AND LEAD
Carol Jo Argus Crannell (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17405

Electromagnetic cascade showers induced by 900-MeV electrons were studied in copper, tin, and lead targets. A small, parallel incident beam with negligible background contamination was employed to achieve good resolution and undistorted development of the shower. The three-dimensional spatial distribution of energy deposition was measured with a CsI(Tl) detector placed at various positions in a small hole in an otherwise solid block of material. Measurements were extended to radii of 7 Moliere lengths and depths of 30 or more radiation lengths. Additional data for showers induced by 200-MeV electrons incident on lead are also presented. The results are compared with the results of previous experiments and with the predictions of recent Monte Carlo calculations. The measured longitudinal distribution of energy is in good agreement with theoretical predictions, while the radial distributions show an unpredicted dependence on the atomic number of the target material. Dissert. Abstr.

N68-36431 New Mexico State Univ., University Park.
THERMAL LIGHT SCATTERING BY IONIC CRYSTALS
Kenneth Oliver White (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17083

The temperature and crystal orientation dependence of the thermal scattering by ionic crystals was studied in the temperature range 78 to 300 degrees Kelvin. The absolute magnitude of the intensity, the temperature independence in first approximation, and the shift in wavelength from the incident wavelength of the components of the ideal crystal Brillouin scattering all agree with theory. The defect scattering increases linearly with temperature in first approximation. The depolarization ratios are approximately zero. The defect scattering as a function of the crystal orientation angle has 2-fold symmetry. These defect scattering results are explained in terms of clouds of point-like scattering units (vacancies) around charged edge dislocations with the dislocations aligned approximately parallel to a single [100] direction in the crystal. The core of the dislocation, a region of great disorder, acts as a source and sink of vacancies and the change in the number density of the vacancies with temperature leads to the observed temperature dependence. The measurement of the scattered light as a function of the angle ϕ allows the intensity of the true, ideal crystal, Rayleigh scattering and the Landau–Placzek ratio for sodium chloride to be determined. Dissert. Abstr.

N68-36462# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
ACTIVITY COORDINATION IN THE FIELD OF ELECTRONICS AND INSTRUMENTATION. PART 3: ELECTRONIC PHYSICS, 1967 [COORDINAMENTO DELLE ATTIVITA NEL CAMPO DELL'ELETTRONICA E DELLA STRUMENTAZIONE. RAPPORTO NO. 3 "ELETTRONICA FISICA"]
B. Rispoli 1967 165 p refs In ITALIAN and ENGLISH
(RT/EL(67)15; Rept.-3)

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N68-36463# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
ELECTRIC EFFECTS IN THE ION BOMBARDMENT OF SEMICONDUCTORS [EFFETTI ELETTRICI NEL BOMBARDAMENTO IONICO DI SEMICONDUTTORI]
R. Gislon, B. Rispoli, and U. Spoglia *In its* Activity Coord. in the field of Electron. and Instr., pt. 3 1967 p 7–50 refs (See N68-36462 23-26)

Some preliminary experiments on single crystals of silicon collision with gas ions are described. Included are actual experiments concerning secondary emissions of electrons by ions, and semiconductor detectors. Among the many effects of the impact of an ion beam on the surface of a semiconductor, the following are identified: (1) potential of electron emission per collision, (2) kinetics of electron emission, (3) ion emission, (4) sputtering, (5) ion penetration of crystal lattice, and (6) damage and defect development in the crystal lattice. Transl. by F.O.S.

N68-36464# Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Laboratorio di Elettronica.

STATIC AND DYNAMIC PROPERTIES OF IRON GARNET AND OF GADOLINIUM [PROPRIETA STATICHE E DINAMICHE DI UN GRANATO DI FERRO E DI GADOLINIO]

A. Sano and A. Serra. *In its* Activity Coord. in the field of Electron. and Instr., pt. 3 1967 p 51–63 refs (See N68-36462 23-26)

Experiments are conducted for determining the static and dynamic properties of gadolinium and iron garnets for use as memory elements for symbols. Single crystal garnets are utilized in the experimental apparatus, which is schematically shown. The hysteresis cycles, and behavior of the garnets at different temperatures are depicted by charts. Transl. by F.O.S.

N68-36465# Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Laboratorio di Electronica.

SUPERFICIAL CONTAMINATION EFFECTS IN THE EMISSION OF ELECTRONS FROM IONS [EFFETTI DI CONTAMINAZIONE SUPERFICIALE NELL'EMISSIONE DI ELETTRONI DA IONI]

F. Catoni and G. Cipolloni. In its Activity Coord. in the field of Electron. and Instr., pt. 3 1967 p 64–76 refs (See N68-36462 23-26)

Modifications of experimental equipment in measuring the effects of surface contaminants on electron emission by ions is considered. These changes result in an improved ion source, a decrease in the scattering energy of the ion beam, and permit the work to be conducted at low constant pressures under stable conditions. Schematics of the equipment and charts showing electron energies of pure and contaminated molybdenum are included. Transl. by F.O.S.

N68-36480# Northwestern Univ., Evanston, Ill.

ELECTRICAL RESISTIVITY STUDIES OF THE RECOVERY OF POINT DEFECTS IN FCC METALS FOLLOWING ELECTRON IRRADIATION

C. L. Snead, F. W. Wiffen, and J. W. Kauffman 1967 18 p refs Presented at the Intern. Conf. on Solid State Phys. Res. with Accelerators, Upton, N. Y., 26 Sep. 1967 Sponsored by AEC (CONF-670924-3) CFSTI: HC $3.00/MF $0.65

Stage I recovery of electron irradiated copper, silver, and gold was examined. Stage I is due to the annihilation of interstitials at vacancies. Most of stage I is due to the collapse of close Frenkel pairs but a small amount of the end of stage I represents the random migration of interstitials to vacancies. Free interstitial migration is seen near 47°K in copper, near 31°K in silver, and is suspected to occur at about 21°K in gold. The amount of recovery due to free interstitial recombination with vacancies decreases in the order copper to silver to gold. It has not yet been possible to positively identify a free migration process in gold. The range of the interstitial interaction increases in going from copper to silver to gold. This makes impurity–interstitial and interstitial–interstitial processes more important at the expense of the interstitial–vacancy recombination. The result is that in gold most interstitials are tied up before they can reach vacancy sinks. In silver and copper this competition for freely migrating interstitials results in less than 100% recovery in stage I. Author (NSA)

N68-36490# Corning Glass Works, Raleigh, N. C. Electronics Div.

OPTICAL AND ELECTRICAL PROPERTIES OF INSULATORS Final Scientific Report, Jul. 1966–Dec. 1967

Robert Engman and Zeev Yager Dec. 1967 138 p refs (Contract AF 61(052)-963) (AFCRL-68-0363; AD-672832)

Various optical properties of paramagnetic salts were studied. We conclude that the dipole movement is the proper operator, to be taken between four component spinors, for spin forbidden transitions. The role of covalency on axial field splittings was also investigated. The electric dipole transition strengths of paramagnetic tetrahedral complexes are calculated with the inclusion of charge transfer states. Author (TAB)

N68-36559# Naval Research Lab., Washington, D. C.

SUPERCONDUCTING LEAD PRESSURE CONTACTS Interim Report

E. E. King and P. I. Peterson 19 Jun. 1968 22 p refs (NRL-6726; AD-673526)

The electrical properties of pressure contacts between superconductors is being investigated to obtain information needed for the design of high-current superconducting switches. It has been concluded from the study of pure lead contacts that a practical switch would utilize clean, roughened surfaces operating under a large mechanical load and at reduced temperatures. The current capacity, as well as the reliability, of the switch can be improved by applying a high-current pulse before use or by paralleling contacts. The voltage-current characteristic exhibits two types of transition differentiated by their abruptness, a nonohmic linear region, and is symmetrical with respect to the current direction. Generally, the critical current can be increased by increasing the load, decreasing the temperature, or roughening the contact surfaces. In addition, highly oxidized contacts have a reduced critical temperature and a correspondingly reduced critical current. Author (TAB)

N68-36589 Cornell Univ., Ithaca, N. Y.

ELECTRON EMISSION FROM SOLIDS UNDER THE INFLUENCE OF LASER RADIATION

Eleftherios Miltiadis Logothetis (Ph.D. Thesis) 1967 178 p Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-665

The electron emission from solids under the influence of laser radiation was investigated in a systematic way. This was accomplished by studying both metals and insulators in the form of evaporated films and single crystals, using three different laser radiations and measuring not only the intensity dependence of the electron emission but also the energy distribution of the emitted electrons. The following materials were studied: gold, stainless steel, CsI, KI and KCl. The three radiations, supplied by a Q-switched laser, had photon energies of 1.17 eV (10600 Å), 1.786 eV (6943 Å) and 3.57 eV(3472 Å) and a maximum intensity of about 15 MW/cm^2. Dissert. Abstr.

N68-36609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE VELOCITY OF DISLOCATIONS IN SILICON CRYSTALS

Ching Hung and I.-Cheng Yeh Nov. 1967 17 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Chinese People's Republic), v. 21, no. 12, 1965 p 1968–1976 (FTD-HT-67-395; AD-673845)

The chemical etching method was used to reveal the dislocations produced by indentation on silicon single crystal specimens. Edge (or 60 degree) dislocation velocities are measured under different shear stresses and at different temperatures (700-900 degrees C). By assuming that the motion is thermally activated the corresponding activation energy is found to be about 2.94 eV. The velocities of edge dislocations and screw dislocations at 900 degrees C are compared, the latter being smaller. Measurements of dislocation velocities on different specimens show the retarding effect of as-grown dislocations. Dislocation multiplication is observed from as-grown dislocations from grain boundaries. Dislocation velocities in process of multiplication are measured. Certain factors affecting the measured values of dislocation velocities are discussed. TAB

N68-36628 Cornell Univ., Ithaca, N. Y.
NUCLEAR MAGNETIC RESONANCE IN HEAVILY NITROGEN-DOPED SILICON CARBIDE
Michael Norman Alexander (Ph.D. Thesis) 1967 92 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-649

Samples of heavily nitrogen-doped silicon carbide (SiC:N) have been studied, using pulse nuclear magnetic resonance (NMR) at a resonance frequency of 8.5 MHz. Measurements were made, for Si^{29} and C^{13}, of the Knight shift $\Delta H/H$, the spin "lattice" relaxation time T_1, and the spin-spin relaxation time T_2. The measurements on the cubic SiC:N samples show a markedly different behavior of the electron interaction with the silicon and carbon sublattices. From the temperature dependence of both the Si^{29} and C^{13} T_1's it is inferred that the electron system is degenerate in the cubic SiC:N samples. The NMR properties of the 6H SiC:N samples are those appropriate to nuclear interaction with paramagnetic electrons localized, at liquid helium temperatures, on donor sites or donor complexes. Published data on resistivity and Hall coefficient indicate that the 6H SiC:N samples studied in this experiment have electron systems characterized by the existence of mobile electrons. Dissert. Abstr.

N68-36671 Cornell Univ., Ithaca, N. Y.
A MODEL CALCULATION OF THE LIQUID STRUCTURE FACTOR OF LIQUID HELIUM-4
William Clayton Kerr (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-660

A model of the atomic motions in liquid He^4 is presented, which allows a calculation of the structure factor S(k). The purpose of the model is to superimpose oscillatory motion, usually associated with the solid phase, onto randomly placed atoms. This randomness represents the liquid nature of the system. The resulting formula requires the experimental phonon-roton spectrum of liquid He^4 to be put into it; and it has as an adjustable parameter the upper limit q_c on integrals over the spectrum. The Debye-Waller factor gives a mechanism in the formula for producing a small maximum in S(k) near $k = 0.6\ A^{-1}$. However, if the parameter q_c is chosen so that the large maximum in S(k) is reproduced, then the constant D is too small for the Debye-Waller factor to have quantitative significance in this formula for S(k). Numerical evaluations of the result for S(k) are given and comparison is made with measurements made at normal vapor pressure and at high pressure. Also, a comparison with measurements of the one-phonon cross section is given. Dissert. Abstr.

N68-36677 California Inst. of Tech., Pasadena.
ABSOLUTE OSCILLATOR STRENGTHS FROM IRON, COPPER, CADMIUM AND GOLD MEASURED BY THE ATOMIC BEAM METHOD
Robert Carl Ashenfelter (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-17057

Absolute f-values for 7 transitions in the first spectra of 4 elements have been measured using the atomic beam absorption technique. The equivalent widths of the absorption lines are measured with a photoelectric scanner and the atomic beam density is determined by continuously weighing a part of it with a sensitive automatic microbalance. The complete theory is presented and corrections are calculated to cope with gas adsorption by the deposit on the microbalance pan and atoms which do not stick to the pan. An additional correction for the failure of the assumption of effusive flow in the formation of the atomic beam at large densities has been measured experimentally. Comparison with other accurately measured f-values, where they exist, shows agreement within experimental errors. Dissert. Abstr.

N68-36699 Stanford Univ., Calif.
A QUANTUM THEORY OF PHOTODETECTOR CORRELATIONS
Thomas Lee Paoli (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17479

Autocorrelation and cross correlation operators for the outputs of photodetectors illuminated by arbitrary radiation fields are studied in terms of quantum field theory. Emphasis is placed on evaluating contributions which originate in the nonzero commutators of the radiation field operators and on estimating the noise inherent in the measurement of cross correlation functions. This theory is applied to the high resolution spectroscopy of thermal radiation by means of the cross correlation obtained with an intense, coherent background illumination. The quantrum theory of photodetector correlations is discussed in terms of symmetrized correlation operators in the Heisenberg Picture. Time dependent perturbation theory utilizing methods of scattering theory is used to obtain the lowest order contributions to the mean and variance of the correlation operators. A finite temperature photodetector is described in terms of the one-electron approximation of the band theory of crystalline solids. Dissert. Abstr.

N68-36703# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHONON DRAG IN INDIUM AND GALLIUM ANTIMONIDES [FONONNOE UVLECHENIE V ANTIMONIDAKH INDIYA I GALLIYA]
D. Kh. Amirkhanova 3 May 1967 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Baku), no. 6, 1963 p 59-65
(FTD-HT-66-776; AD-673685)

Measurements of the transverse and longitudinal Nernst-Ettinghausen (N.-E.) effect were carried out for p-InSb and p-GaSb with different impurity contents at 20-300K, in magnetic fields of < or = 26,000 oe. In all GaSb samples the N.-E. effect has a negative sign and the N.-E. field increases rapidly as the temp. is lowered. It is suggested that below 50K, the Rutherford mechanism of scattering of current carriers prevails. At < 100K, in sufficiently pure InSb and GaSb samples the phonon-drag effect predominates in thermomagnetic and thermoelectric effects. It is also suggested that in both GaSb and InSb the charge transfer is accomplished by 2 types of holes: heavy and light ones. The effect of phonon drag is connected with the heavy holes. The valence zones of both InSb and GaSb are doubly degenerate at k = 0. Author (TAB)

N68-36709# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMALLY AND OPTICALLY STIMULATED PHENOMENA IN CADMIUM-SULFIDE SINGLE CRYSTALS [TERMICHESKI I OPTICHESKI STIMULIROVANNYE YAVLENIYA V MONOKRISTALLAKH SULFIDA KADMIYA]
A. Aidla and Ya. Kirs 30 Aug. 1967 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Est. SSR, Ser. Tekhn. i Fiz.-Mat. Nauk (Tallin), no. 3, 1966 p 354-359
(FTD-HT-67-199; AD-673810)

Results are reported of an investigation of the thermo-luminescence, the thermally stimulated current, the optical flash and optical quenching of the photoconductivity and luminescence of a number of CdS single crystals. TAB

N68-36727 California Univ., Los Angeles.
OPTICAL DETECTION OF SPIN LATTICE RELAXATION IN Nd-LaES AND CROSS RELAXATION IN Nd-CeES
John Joseph Wooldridge (Ph.D. Thesis) 1967 170 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-234

A weak optical absorption line has been used to measure the spin lattice relaxation times of natural Nd and Nd-142 doped

into lanthanum ethyl-sulfate. The measurements were carried out at a microwave pump frequency of approximately 23 kMc with the applied magnetic field parallel to the three fold symmetary axis of the crystal. Measurements within the temperature range 1.28 to 2.15°K show a bottlenecked relaxation rate for 3 percent Nd-142. A direct observation of cross relaxation between Nd-142 and Ce in Nd doped cerium ethyl-sulfate was carried out by optically monitoring the Nd spin population while pumping on Ce with microwave radiation. These measurements were performed within the temperature range 1.28°K to 2.14°K. The Nd resonance was also pumped directly with microwave radiation within the same temperature range and at 4.24°K. The microwave frequency was approximately 23 kMc and the magnetic field was parallel to the three fold axis. Dissert. Abstr.

N68-36738# Dartmouth Coll., Hanover, N. H.
COLOR CENTER TRANSFORMATIONS IN LiF:Mg
Michael R. Mayhugh (M.A. Thesis) Oct. 1967 50 p refs
(Contract AT(30-1)-3474)
(NYO-3474-3(APP. B)) CFSTI: HC $3.00/MF $0.65

A systematic study has been made of the changes in the color centers in LiF:Mg due to thermal and optical treatments. The radiation-induced absorption at low dose (about 5000 R) is shown to result from the F band at 250 nm and gaussian bands centered roughly at 380, 310, 270, 225, 205, and 196 nm. The 310-nm absorption band consists of two overlapping bands, one of which results from trapped electrons. Absorption bands located at wavelengths shorter than 196 nm are likely. The band is found to be asymmetric, perhaps because of a prominent K band. An explanation of the effects due to annealing and optical bleaching is made in terms of a model assuming hole centers absorbing in the 310-to 380-nm region. An alternate model based on absorption due only to trapped electrons in the 310-to 380-nm region is found to also explain the data. Author (NSA)

N68-36741 Utah Univ., Salt Lake City.
IONIZED IMPURITY SCATTERING AND ALFVEN WAVE DAMPING IN BISMUTH
Donald Haviland Brownell, Jr. (Ph.D. Thesis) 1967 61 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 67-17560

The screening charge density and the potential matrix elements of a fixed charge in bismuth are calculated using a density matrix approach. Numerical values of the charge density in the three principal crystal directions are obtained using the band parameters of Smith, Baraff and Rowell. The resulting charge density oscillations are interpreted on the basis of the band structure of bismuth. The theory of the relaxation frequency tensor for an ellipsoidal conduction band is developed and calculated for the case of the electron and hole bands in bismuth assuming ionized impurity scattering. The theory of Alfvén wave propagation is developed, and the ratios of relaxation times for several different field orientations are calculated. The results are compared with the data of McLachlan. Possible mechanisms for the damping, including Frenkel defects, are discussed. Dissert. Abstr.

N68-36743 Syracuse Univ., N. Y.
SPECIFIC HEAT AND HALL EFFECT MEASUREMENTS OF CHROMIUM-VANADIUM AND CHROMIUM-MOLYBDENUM ALLOYS
Barrie Steven Shabel (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-12079

The specific heat, measured at constant pressure in an adiabatic calorimeter over the temperature range from 125°K to 625°K, could be separated into lattice, dilatational and electronic contributions. The electronic term could be written as $C_E = \gamma^* T$ with γ^* an effective electronic specific heat coefficient. Values of γ^* ranged from 12–16 × 10^{-4} cal/mole-deg^2 for the Cr–V alloys and from 5–12 × 10^{-4} cal/mole-deg^2 for the Cr–Mo alloys. The Hall Effect measurements showed that Cr, the Cr–V alloys, the Cr–Mo alloys and Mo all had positive Hall coefficients, indicative of predominant hole conduction. Pure Cr yielded field-dependent Hall coefficients at 4.2°K and 77°K, which could be fitted using the standard two-band model, in fields up to 147 kilogauss. The Cr–Mo alloys, however, yielded Hall coefficients results that were quite similar to those found in Ag–Au alloys. The Hall coefficients ranged from 9–13 × 10^{-13} volt-cm amp-gauss. Dissert. Abstr.

N68-36748 Stanford Univ., Calif.
FLUXOID QUANTIZATION IN SUPERCONDUCTING VANADIUM
Stuart Thomas Spence (Ph.D. Thesis) 1967 104 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17508

When a hollow cylinder is held at a fixed temperature in its transition region and an axial field is varied, fluxoid quantization will cause a downward shift in transition temperature periodic in the flux through it. This shift ΔT_c can be observed as a change in resistance, measured with a small direct current along the cylinder. When these measurements were made on vanadium by Meyers and Little they found no effect, although they could have observed one 200X smaller than predicted. The experiment was repeated in the present investigation using a digital signal averager for increased sensitivity, with the results: (1) A temperature shift ΔT_c periodic in flux was found throughout the transition region. (2) Above a certain measuring current the amplitude of ΔT_c fell off very rapidly, and more rapidly at higher temperatures. (3) The electron wavelength at this critical measuring current was comparable to the cylinder circumference. A structure appearing in the signal suggested this was the cause of the decrease in ΔT_c. Dissert. Abstr.

N68-36784# Kansas Univ., Lawrence. Dept. of Physics and Astronomy.
EXPERIMENTAL VERIFICATION OF THE CORRELATION FACTOR FOR VACANCY DIFFUSION IN SILVER CHLORIDE
Joseph P. Gracey Sep. 1967 51 p refs
(Contract AT(11-1)-1197)
(COO-1197-21) CFSTI: HC $3.00/MF $0.65

An investigation was made of the free vacancy experimental correlation factor for AgCl. Diffusion and conductivity measurements were made on AgCl doped with small amounts of $CdCl_2$ in the temperature range from 125 to 225°C. NSA

N68-36814# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
THE THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF TUNGSTEN-26 WEIGHT PERCENT RHENIUM
A. D. Feith 15 Nov. 1967 21 p refs Presented at the 7th Conf. on Thermal Conductivity, Gaithersburg, Md., 15 Nov. 1967
(Contract AT(40-1)-2847)
(GEMP-562; R-67-NMP-2; CONF-671110-15) CFSTI: HC $3.00/MF $0.65

Radial heat flow measurements of the thermal conductivity of W-26Re (wt%) have been made at 300 to 2200°C. These data identify a small positive temperature coefficient on conductivity with conductivity values ranging from 56.0 $Wm^{-1}deg^{-1}$ at 300°C to about 69.0 $Wm^{-1}deg^{-1}$ at 2200°C. Electrical resistivity measurements are also reported for both W-26Re and for unalloyed tungsten. This information was employed to calculate the electronic contribution to the thermal conductivity of the W-26Re alloy. At 300°C the electronic contribution was calculated to be about 65% of the thermal conductivity, whereas at 2200°C the conductivity is about 90% electronic. Author (NSA)

N68-36824# Vanderbilt Univ., Nashville, Tenn.
DEFORMATION STUDIES OF SUPERLATTICE STRUCTURES Progress Report, 1 Dec. 1966–30 Nov. 1967
James J. Wert and Stephen G. Cupschalk 1 Dec. 1967 5 p
(Contract AT(40-1)-3091)
(ORO-3091-7) CFSTI: HC $3.00/MF $0.65

Progress on studies of the effects of deformation Cu-Pt, and Fe-Al superlattice alloys is reported. NSA

N68-36827 Stanford Univ., Calif.
PHOTOEMISSION AND OPTICAL STUDIES OF THE ELECTRONIC STRUCTURE OF NiO, CoO, and V_2O_4
Richard James Powell (Ph.D. Thesis) 1967 185 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-17484

Photoelectric emission and optical reflectance measurements have been performed on NiO, CoO, and V_2O_4 in order to determine details of their electronic structures and to examine the predictions of the theoretical models. Photoemission from these materials has been measured both above and below their magnetic transition temperatures. Details of experimental techniques are presented, including a new high-vacuum cleaving apparatus used for cleaving the NiO and CoO single crystals, and a method of preparing V_2O_4. The optical constants of NiO and CoO have been determined for photon energies from 1 to 26 eV by a Kramers–Kronig analysis of their reflectance spectra. The photoelectric yield of V_2O_4 displays an abrupt change at the 67°C transition temperature. Photoelectron energy distributions show that the relative positions of the Fermi and vacuum levels are the same at 25°C and 100°C, while the top of the filled levels is 0.6 eV lower in energy (relative to the Fermi and vacuum levels) at 25°C than at 100°C. Dissert. Abst.

N68-36847# Iowa State Univ. of Science and Technology, Ames. Dept. of Physics.
THERMAL CONDUCTIVITY OF MAGNESIUM STANNIDE
J. J. Martin, H. R. Shanks, and G. C. Danielson 27 Oct. 1967 9 p refs Presented at 7th Conf. on Thermal Conductivity, Gaithersburg, Md., 13–16 Nov. 1967
(IS-1712; CONF-671110-1) CFSTI: HC $3.00/MF $0.65

The thermal conductivity of the semiconductor Mg_2Sn has been determined in the temperature range 80 to 700°K from measurements of the thermal diffusivity. At low temperatures the thermal conduction is entirely lattice conduction, as shown by our earlier measurements from 4 to 300°K. At higher temperatures, however, results show that bipolar-electronic conduction (diffusion and recombination of electron-hole pairs) becomes important and actually equals the lattice conduction at 700°K. The difference between the measured thermal conductivity and the lattice thermal conductivity is in good quantitative agreement with the calculated bipolar-electronic thermal conductivity, and this agreement gives strong support to the theory of bipolar conduction in semiconductors. Author (NSA)

N68-36852# California Univ., Livermore. Lawrence Radiation Lab.
OPTICAL PROPERTIES AND ELECTRONIC BAND STRUCTURE OF ZINC: REFLECTANCE AND PHOTOEMISSION STUDIES
Lawson P. Mosteller, Jr. 22 Aug. 1967 101 p refs
(Contract W-7405-eng-48)
(UCRL-50307) CFSTI: HC $3.00/MF $0.65

Reflectance and photoemission measurements were used to investigate the optical properties and electronic band structure of Zn. The quantum yield, work function, energy distribution, and temperature dependence of photoemission were measured on a single crystal of Zn cleaved in the basal plane. The crystal was cleaved and measurements made at pressures of 10^{-9} torr to ensure surface cleanliness during reflectivity measurements. The reflectometer designed for these measurements is described. The reflectivity for the basal plane was measured for four different angles of incidence in range from 50 to 70°. Reflectance of air-exposed Zn was compared with noncontaminated Zn; air exposure drastically reduced reflectance. Theoretical expressions for the reflectance coefficients for the basal plane were derived in terms of angle of incidence, polarization, and the four optical constants $n_\perp$, $k_\perp$, $n_\parallel$, and $k_\parallel$. The optical constants $n_\perp$ and $k_\perp$ were determined from the measured reflectance coefficients. Author (NSA)

N68-36855# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
MAGNETIC RESONANCE STUDIES OF THE CRYSTAL FIELD DISTORTIONS IN THE LiF:Fe-3+ SYSTEM
I. Ursu, S. V. Nistor, A. Nicula, and V. Niculescu 1967 13 p refs
(IFA-IS-46)

Single crystals of LiF doped with less than 0.01% Fe^{3+} ions were investigated by ESR and NMR methods in the range from 77 to 453°K. The spectra observed are explained on the basis of the hypothesis of crystal field distortion. Author (NSA)

N68-36882# Academia R. P. R., Bucharest.
SPIN-HAMILTONIAN DESCRIPTION OF THE ESR SPECTRA OF THE $S-6_S2$ IONS IN TRIGONAL CRYSTALLINE FIELDS
V. Lupei, A. Lupei, and I. Ursu 1967 14 p refs Transl. into ENGLISH from Acad. Rep. Populare Romine, Inst. Fiz. Atomica (Bucharest)
(IFA-IS-47)

A spin Hamiltonian that describes ESR spectra of $^6S_{5/2}$ ions in trigonal crystalline fields as a function of the orientation of the crystal in the external magnetic field is given. The method of determining the spin-Hamiltonian parameters is described. Author (NSA)

N68-36885# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
SUPERCONDUCTIVITY OF FUSED SAMPLES OF THE SYSTEMS Nb–Sn, Nb–Al, Nb–Ga, V–Si, AND V–Ga
W. Kunz and E. Saur Apr. 1967 33 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 189, 1966 p 401–416 Presented at Low Temp. Specialist Comm. of Ger. Phys. Soc., Karlsruhe, W. Ger., 20 Mar. 1964
(CONF-640310-1; CONF-651-92)

Samples of Nb–Sn, Nb–Al, Nb–Ga, V–Si; V–Ga, and Nb_3Sn with partial replacement of Nb by Ti, Zr, V, and Ta were melted in an arc furnace. The transition temperatures and the transition breadths of these samples in the untempered and the tempered states were measured by inductive and resistive methods. A correlation of the binary samples and of their superconductive properties with the known phase diagrams of the corresponding systems was undertaken by means of structural investigations. Author (NSA)

N68-36923*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THERMAL NOISE IN SPIN-PHONON SYSTEMS
Harold A. Sabbagh (Rose Polytech. Inst.) Sep. 1968 49 p refs
(NASA-TM-X-63366; X-52368-376) CFSTI: HC $3.00/MF $0.65
CSCL 20I

Starting with the combined lattice and spin-lattice Hamiltonian densities, field equations for transverse elastic waves are derived. An electrical transmission line analog is established which employs an impedance function (matrix) calculated using the density-matrix formalism for the interaction of a paramagnetic spin system with acoustic vibrations. Associated with the impedance function is a continuous distribution of thermal noise voltage sources whose statistical characteristics are determined by a form of the (Nyquist) fluctuation–dissipation theorem. The significance of positive and negative temperatures on the spectral density of the noise sources is pointed out. Application of the theory is made in determining the spatial correlation and spectral densities of the resultant acoustic noise fields in infinite and bounded systems. Author

N68-36956*# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
EXPERIMENTAL INVESTIGATION OF ELECTRON-PHONON INTERACTIONS IN SEMICONDUCTORS Final Report, 18 Dec. 1966-30 Jan. 1968
Joseph P. Martin Jan. 1968 60 p refs
(Contract NAS8-21046)
(NASA-CR-98005) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Techniques for aligning, polishing and cutting semiconductor crystal rods for use in acoustic propagation studies of electron phonon interaction were evolved. A CdS vapor deposition system was set up for production of thin film transducers. Reflection electron diffraction was used to determine that highly polished substrate surfaces were found to be necessary for oriented film growth. The transduction efficiency of the films grown to date is about 10 lb less than that obtained with x-cut quartz transducers. Electron heating effects on mobility were used to evaluate the theoretical predictions of acoustic gain. Electron energy relaxation time was measured from electron heating data. Relaxation time was found to be strongly dependent on electron temperature (4×10^{-7} sec at 4.2°K to 8×10^{-10} sec at 28°) and independent of lattice temperature. Temperature dependence measurements of acoustic attenuation yielded values of absolute attenuation of 12 db/cm at 4.2°K and of acoustoelectric coupling coefficient of $K^2 = 3.3 \times 10^{-4}$. Author

N68-36972# Brookhaven National Lab., Upton, N. Y.
THE PHONON DISPERSION RELATION FOR HCP HE^4 WITH A MOLAR VOLUME OF 21.1 CM^3
T. A. Kitchens, V. J. Minkiewicz, F. P. Lipschultz, G. Shirane, and R. Nathans 1967 4 p refs Presented at the Conf. on Low Temp. Phys., St. Andrews, Scotland
(BNL-12596; CONF-680808-1) CFSTI: HC $3.00/MF $0.65

The classical Born-von Karman theory of lattice dynamics fails to predict stable lattice vibrations (phonons) in the ^4He hcp phase. This failure is due to the dominant role played by the zero-point motion in crystalline helium; at low molar volumes of ^4He, the amplitude of the zero-point motion is approximately 1/3 of the nearest neighbor distance and the zero-point energy is more than 95% of the total energy. The first direct observation of phonons in oriented hcp ^4He single crystals are reported and compared with the numerical calculations by Gillis, Koehler, and Werthamer. NSA

N68-37019# Brookhaven National Lab., Upton, N. Y.
SUPERCONDUCTIVE PHENOMENA IN ULTRA THIN FILMS
Myron Strongin and O. F. Kammerer [1967] 22 p refs Presented at Appl. Superconductivity Conf. and Exhibition, Austin, Tex.
(BNL-11901; CONF-671116-1) CFSTI: HC $3.00/MF $0.65

Work on the superconducting transition temperatures of ultra-thin films is reviewed. Some explanations for the change in T_c with respect to bulk materials are considered. An investigation of the possibility of electron pairing across dielectric barriers using superconductor-dielectric-superconductor layers is summarized. The preparation of the thinnest possible electrically continuous films, results of T_c measurements of these films, and possible explanations of the results are discussed. NSA

N68-37051*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
PROTON-PRODUCED DEFECTS IN n-TYPE SILICON
Roger A. Breckenridge Washington Oct. 1968 27 p refs
(NASA-TN-D-4830) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Defect energy levels and concentrations were determined for n-type silicon single crystals with initial resistivities between 10 and 200 ohm-cm after 22.4 -MeV proton irradiations. Two defect energy levels were located: one at 0.17 eV below the bottom of the conduction band and one at 0.41 eV below the bottom of the conduction band. The introduction rate of the oxygen-vacancy complex was independent of the oxygen content of the silicon for the samples investigated. Heat treatment of Czochralski-grown silicon at 1000°C for 65 hours had no effect on the introduction rate of the oxygen-vacancy complex. Author

N68-37055*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EFFECTS OF ZINC CONCENTRATION ON OUTPUT OF ZINC DOPED GERMANIUM DETECTORS
Wilfred D. Hesketh Washington Oct. 1968 36 p refs
(NASA-TN-D-4834) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The effects of dopant concentration on the operation of far infrared detectors were investigated theoretically and experimentally. The theoretical investigation shows that an optimum dopant concentration does exist in extrinsic quantum detectors. This optimum point will vary with changes in the host or dopant material. The optimum will also vary with changes in the integrating chamber used. In the experimental investigation, an integrating chamber was constructed and evaluated for its characteristics. These characteristics, radiation loss coefficient due to reflections from the input port, and radiation loss due to absorption by the integrating chamber walls were then used in predicting the optimum dopant concentration of zinc doped germanium. Ten pairs of detectors were produced of various dopant concentration with equal dopant concentration in the two detectors of each pair. The output of the detectors was measured, the measurement being normalized to the maximum value and plotted. These curves were then compared with similarly normalized theoretical curves. The optimum dopant concentration occurred as predicted but with a greater slope on each side of the optimum point than was predicted. Author

N68-37061# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
MIGRATION UNDER THE EFFECT OF AN ELECTRIC FIELD OF Ag^{110} AND Sb^{124} IN SILVER [MIGRATION SOUS L'EFFET D'UN CHAMP ELECTRIQUE DE ^{110}Ag ET ^{124}Sb DANS L'ARGENT]
Nguyen Van Doan and Gilbert Brebec Apr. 1968 38 p refs In FRENCH; ENGLISH summary
(CEA-R-3480) CFSTI: HC $3.00/MF $0.65

The most recent theories relative to the influence of an electric field on the migration of point defects in metals are briefly recalled stressing their similarities and the different hypotheses on which they are based. In order to relate the various physical constants of the phenomenon, the flux of a solute is expressed in terms of diffusion coefficients and 'effective valences' defined in thermodynamics of irreversible processes. Experimental results on the electromigration of Sb^{124} and Ag^{110} in silver show that these atoms migrate towards the anode with effective valences of −95 and −16 respectively for Sb^{124} and Ag^{110} at temperatures in the region of 900°C. Estimates were made on the resistivities that should be used in the different theories in order to compare their predictions with experimental results. ESRO

N68-37085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Lab.
ELECTRIC CONDUCTIVITY OF HIGHLY REFRACTORY OXIDES AT HIGH TEMPERATURE [ELEKTROPROVODNOST VYSOKOGENEUPOTNYKH OKISLOV PRI VYSOKIKH TEMPERATURAKH]
S. V. Palguev, A. D. Neuymin, Z. S. Volchenkova, and L. D. Yushina 30 Jun. 1967 28 p refs Transl. into ENGLISH from AN SSSR, Inst. Khim. Silikat i Oksidy v Khim Vysokikh Temperatur, 1963 p 118-134
(FTD-MT-66-126; AD-673409)

The electrical conductivity of pure oxides and their mixtures was investigated. The pure oxides were (a) the dioxides of zirconium, thorium, and cerium; (b) the oxides of beryllium, magnesium,

calcium, and strontium; and (c) the oxides of yttrium, lanthanum, and neodymium. In all these groups, the temperature dependence of the electrical conductivity was determined and plotted on graphs. The oxide mixtures consisted of (a) systems of oxides based on zirconium dioxide (ZrO_2-BeO, ZrO_2-MgO, ZrO_2-CaO, ZrO_2-SrO, ZrO_2-BaO), (b) systems based on thorium dioxide (ThO_2-BeO, ThO_2-MgO, ThO_2-CaO, ThO_2-SrO, ThO_2-BaO), (c) systems based on cerium dioxide (CeO_2-BeO, CeO_2-MgO, CeO_2-CaO, CeO_2-SrO, CeO_2-BaO), and (d) the systems CeO_2-ZrO_2 and $(0.75CeO_2 0.25ZrO_2)$-CaO. In all these mixtures, the isotherms of the electrical conductivity at 1000C were plotted. The experimental results lead the authors to the conclusion that the electrical conductivity of solid oxides is sensitive to many of their other properties; such as the tendency to react with one another and with the components of the gas phase and the tendency to be reduced. The conductivity also depends on the nature of the phases present.
Author (TAB)

N68-37086# Sandia Corp., Albuquerque, N. Mex.
ELECTRICAL PROPERTIES OF NEUTRON-IRRADIATED SILICON AT 76 DEG K; HALL EFFECT AND ELECTRICAL CONDUCTIVITY
Herman J. Stein Jun. 1968 32 p refs Presented at the Conf. on Space and Nucl. Radiation Effects, Bozeman, Mont.
(Contract AT(29-1)-789)
(SC-DC-68-2328; CONF-680706-1) CFSTI: HC $3.00/MF $0.65

Defects produced in p-type silicon by neutron irradiation were investigated using electric conductivity and Hall effect measurements at 76°K. Samples from crucible-grown (1, 10, and 50 ohm-cm) and float-zone (10 ohm-cm) boron-doped silicon were irradiated at 76°K with nearly fission-spectrum neutrons and annealed isochronally between 76 and 700°K. The electrical properties of neutron-irradiated p-type silicon exhibit an illumination dependence similar to that observed previously in n-type silicon and attributed to the presence of defect clusters. Therefore, neutron-produced changes in the electric properties of p-type silicon also are attributed to defect clusters. The sensitivity to illumination was observed for all resistivities and for both crucible and float-zone p-type silicon. Neutron-produced changes in the electrical properties measured after annealing to 150°K are found to be qualitatively consistent with an insulating void model for cluster-space-charge regions.
Author (NSA)

N68-37088# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
AN ANALYSIS OF THE EFFECTS OF IONIZING RADIATION IN ONE-DIMENSIONAL METAL-OXIDE-SEMICONDUCTOR STRUCTURES Final Report
C. W. Gwyn May 1968 235 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(UNM-290-861; SC-CR-68-3659; EE-153) CFSTI: HC $3.00/MF $0.65

A study of the properties of the SiO_2 layer has been performed wherein the applicability of using an energy band model for amorphous SiO_2 has been qualitatively investigated. The charge trapping characteristics of the oxide as a function of the radiation exposure have been summarized and the similarities between the ionizing radiation effects in fused silica, quartz, and SiO_2 are noted. A broken bond model for hole trapping in the oxide after irradiation is proposed. The application of such a model offers plausible explanations for the buildup of the radiation-induced charge in the oxide and subsequent annealing of the charge as a function of temperature and exposure to ultraviolet radiation. In addition, possible radiation hardening techniques for preventing the charge buildup in the oxide are suggested; these are based upon the concepts presented in the discussion of the model.
Author (NSA)

N68-37122# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF THE THERMOELECTRIC PROPERTIES OF $Pb_{(1-x)}Sn_xTe$ [CONTRIBUTION A L'ETUDE DES PROPRIETES THERMOELECTRIQUES DE SOLUTIONS $Pb_{(1-x)}Sn_xTe$]
Dominique Borde (Ph.D. Thesis--Paris Univ.) 1967 90 p refs In FRENCH; ENGLISH summary
(CEA-R-3399) CFSTI: HC $3.00/MF $0.65

The present work concerns the study of the electrical properties (thermoelectric power, electrical resistivity and Hall coefficient) of PbTe and SnTe crystals and of solid polycrystalline solutions of $Pb_{1-x}Sn_xTe$ ($0.1 < x < 0.6$) between 80° and 800°K. From the temperature dependence of these properties and the effect of the addition, it has been possible to characterize the semiconductor nature of these solutions, and to approach their band structure; in particular the forbidden gap behaviour in these solutions has been analyzed and evidence for the existence of a double valence band has been obtained.
ESRO

N68-37126# Utah Univ., Salt Lake City. Dept. of Physics.
IR ABSORPTION SPECTRUM OF H+ IN RUTILE
Owen W. Johnson [1967] 3 p refs Presented at Am. Inst. of Phys. Summer Meeting, Seattle, 2 Sep. 1967
(Contract AT(11-1)-1434)
(COO-1434-04; CONF-670951-1) CFSTI: HC $3.00/MF $0.65

It was established by diffusion doping that previously observed infrared absorption lines in rutile result from a proton or a deuteron trapped near a substitutional cation of valence 3. Three such impurity centers (involving Fe, Al, and Ga) were identified, and a fourth was detected but not identified. The exact locations of the absorption peaks at room temperature and at He temperature are tabulated. Preliminary results on H diffusion at 400 to 500°C are discussed briefly.
NSA

N68-37136# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires
STUDY OF THE EFFECT OF NEUTRON AND ELECTRON IRRADIATIONS ON THE LOW TEMPERATURE THERMAL CONDUCTIVITY OF GERMANIUM AND SILICON [ETUDE DE L'EFFET DES IRRADIATIONS NEUTRONIQUE ET ELECTRONIQUE SUR LA CONDUCTIBILITE THERMIQUE AUX BASSES TEMPERATURES DU GERMANIUM ET DU SILICIUM]
Michel Vandevyver (Ph.D. Thesis--Paris Univ.) 1968 74 p refs In FRENCH; ENGLISH summary
(CEA-R-3387) CFSTI: HC $3.00/MF $0.65

The main results obtained from this work are the following: neutron irradiation (at 300°K) produces lattice defects in germanium and silicon, and a corresponding very large lowering of the thermal conductivity is observed in the low temperature region (4–300°K). The results obtained have been explained with the help of the following hypotheses: for silicon a scattering of phonons by the stress fields produced by the defects; for germanium, a supplementary scattering of the electron-phonon type. Annealing treatments carried out on these materials above 373°K restored the thermal conductivity over the whole temperature range of the measurements (4–300°K); in the case of both germanium and silicon there were two steps in the annealing process. A study of the thermal conductivity of germanium (initially P or N) after an electronic irradiation showed that the scattering of phonons could depend on the state of charge of the defects thus produced.
Author (ESRO)

N68-37143# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
CORRELATION FACTOR AND ISOTOPE EFFECT IN SOLID-STATE DIFFUSION [FACTEUR DE CORRELATION ET EFFET ISOTOPIQUE EN DIFFUSION]

Maurice Gerl May 1968 61 p refs In FRENCH; ENGLISH summary
(CEA-BIB-120) CFSTI: HC$3.00/MF$0.65

Consideration of diffusion mechanisms in a crystal shows that the successive jumps of a tracer atom are correlated one another; this introduces a correlation factor f_i in the expression of the diffusion coefficient D_i of the tracer. For self-diffusion in isotopic structures, f_i is a purely geometrical characteristic of the jump mechanism; for self-diffusion in anisotropic structures and for impurity diffusion, the calculation of f_i involves different jump frequencies. Methods for analyzing self-diffusion in dilute alloys are described; in Lidiard's theory, measurements of Di and b lead to the value of f_i; in Howard and Manning's theory, measurements of D_i, b and f_i give the jump frequencies involved in the diffusion process. Measurement of the isotope effect in diffusion is a method of determining f_i ΔK_i, where ΔK_i is the fraction of the kinetic energy residing in the tracer during the jump. Le Claire's theory provides a relation between ΔK_i and the formation volume ΔV_f of a vacancy. Finally the most frequently used experimental techniques for determining f are given. Author (ESRO)

N68-37176# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
PN JUNCTION FOR THE DETECTION OF α AND β PARTICLES AND OF ELECTROMAGNETIC RADIATION [JONCTION PN POUR LA DETECTION DES PARTICULES α ET β ET DES RAYONNEMENTS ELECTROMAGNETIQUES]
Christian Ristori Apr. 1968 34 p refs In FRENCH; ENGLISH summary
(CEA-BIB-97) CFSTI: HC$3.00/MF$0.65

This work concerns the theoretical study of a PN junction, the study of the various characteristics of diffused PN junctions, of surface barrier junctions and of p, i, n junctions compensated with lithium, and finally the applications of these detectors for heavy particles, of beta particles and of electromagnetic radiation (gamma and infrared). Author (ESRO)

N68-37182# Alberta Univ., Edmonton. Dept. of Physics.
PRESSURE-DEPENDENCE OF THE PHONON SPECTRUM OF PB FROM TUNNELING MEASUREMENTS
J. P. Franck, W. J. Keeler, and T. M. Wu (State Univ. of New York, Binghamton) 1968 11 p refs Supported by Natl. Res. Council of Can.

The phonon spectrum of Pb has been obtained as a function of pressure from electron tunneling data. The pressure dependence of the electron–phonon coupling constant and other parameters shows that Pb tends towards weaker coupling with increasing pressure. Author

N68-37191# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOELECTRONIC PROPERTIES OF URANIUM ZIRCONIUM CARBIDES IN CESIUM VAPORS [TERMOELEKTRONNYYE SVOYSTVA URANIUM ZIRCONIUM V PARAKH TSEZIYA]
A. G. Fedorus and P. M. Marchuk 20 Jul. 1967 10 p refs Transl. into ENGLISH from Akad. Nauk Ukr. Inst. Probl. Materialovedenya. (Kiev), 1965 p 274–277
(FTD-HT-23-898-67; AD-673696)

The thermoelectronic emission of uranium mono- and dicarbides and of solid solution of uranium and zirconium carbides (UC)0.2:(ZrC)0.8 was studied in vacuo and the thermoelectronic emission of (UC)0.2:(ZrC)0.8 solid solution was studied in the presence of cesium vapor. The temperature varied from 1620K to 2200K and the cesium vapor pressure varied in a wide range (saturation pressures corresponding to 70-200C). Author (TAB)

N68-37261 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.
ON THE THEORY OF VORTICES IN TYPE-2 SUPERCONDUCTORS
A. G. van Vijfeijken (Ph.D. Thesis–Amsterdam Univ.) 1968 122 p refs *Its* Res. Rept. Suppl. No. 8

Consideration is given to the theory of some properties of the mixed state of type-II superconductors. First, vortices at rest are studied. Here the properties of isolated vortices are reviewed and then an analysis of a system of interacting vortices is made. A new method to investigate the stability of the vortex lattice is given. An expression for the electronic heat capacity in the mixed state is derived and a comparison with experiments is made. An equation is derived which is the analogue of Bernoulli's equation for a classical frictionless fluid. A macroscopic theory for the motion of vortices is developed. The two most important effects arising from the motion of vortices are the apparent electric resistivity and the Hall effect. As to the resistivity, it is found from the calculations that this quantity is essentially determined by the normal-state resistivity and by the volume fraction occupied by the normal vortex cores. A comparison with experiments shows that this theoretical result is in fair agreement with the data. For the Hall angle in the mixed state it is derived that this is the same as the Hall angle of the normal state at a magnetic field equal to the field present in the vortex cores. There is, however, a substantial disagreement between the theoretically predicted and experimentally observed Hall angles. A brief discussion of two similar theories for vortex motion is given. Author

N68-37281# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE SURFACE PHOTOELECTRIC EFFECT IN FERROMAGNETIC SUBSTANCES [O POVERKHNOSTNOM FOTOELEKTRICHESKOM EFFEKTE V FERROMAGNETIKAKH]
S. V. Vonkovski and A. V. Sokolov Oct. 1968 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 78, no. 2, 1951
(TR-50)

An anomalous photoelectric behavior of nickel is investigated. When the photoelectric yield is plotted as a function of temperature, a discontinuity in slope appears near the Curie temperature. A ferromagnetic substance is considered to consist of a mixture of two electron gases corresponding to the two possible orientations of spin. An expression is obtained for the fractional change in photoelectric yield which is proportional to the square of the relative spontaneous magnetization. However, no quantitative comparisons between theory and experiment are made since the theoretical expression contains several parameters which may be difficult to evaluate. Author

N68-37296 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.
THE PHOTOCHEMICAL INTERPRETATION OF SLOW PHENOMENA IN CADMIUM SULPHIDE
E. Tscholl (Ph.D. Thesis—Tech. Univ., Eindhoven) 1968 99 p refs *Its* Res. Rept. Suppl. No. 6

Photochemical interpretations of slow (opto-electronic) phenomena in CdS crystals are investigated theoretically and experimentally. It is seen that the presence of Ni impurity atoms has a major influence on some of these slow phenomena. Consequently, impurity atoms must be included in the considerations if a model for photochemical bulk reactions is to be developed. A nonphotochemical interpretation is possible for the phenomenon of the slow decrease of the photocurrent at constant illumination, if this decrease is connected with thermal quenching. For the slow changes in the spectra of thermally stimulated conductivity, which form the main body of the experimental part of this study, a photochemical interpretation seems to be more adequate. A working hypothesis is drawn up: with the aid of isovalent impurity atoms

photochemical reactions in CdS can occur a little below room temperature. This was tested by experiments on crystals doped with Cu or Ag and to which in addition (isovalent) Ni was added. Author

N68-37301# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING OF SUBLIMATED LAYERS OF CADMIUM SULFIDE AND CADMIUM SELENIDE FOR SEMICONDUCTOR USE [POLUCHENIYE SUBLIMIROVANNYKH SLOEV SERNISTOGO I SELENISTOGO KADMIYA DLYA TSELEY POLUPROVODNIKOVOY ELEKTRONIKI]
E. B. Kaganovich, S. V. Svechnikov, and Yu. A. Tkhorik *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 25–42 refs (See N68-37299 23-09)

The usefulness of cadmium sulfide and cadmium selenide for semiconductors is discussed, and the present methods for obtaining thin films are delineated. They include (1) thermal evaporation; (2) cathode sputtering; (3) precipitation; (4) chemical deposition; (5) precipitation from suspension; (6) deposition from ion beam; and (7) electrodeposition. The thermal evaporation method is discussed in detail, with special attention focused on the technological procedures utilized for deposition of CdS and CdSe films and the factors which affect the process. Author

N68-37307# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR NEGATIVE RESISTANCES BASED ON DIELECTRIC FILMS [PELINEYNYYE OTRITSATEL'NYYE SOPROTIVLENIYA NA OSNOVE DIELEKTRICHESKIKH PLENOK]
M. M. Nekrasov and G. I. Bogdan *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 85–91 refs (See N68-37299 23-09)

The negative resistance in semiconductors is discussed. Various explanations of negative resistance are reviewed. A report follows of tests made on metal–metal oxide–metal structure based on oxide films of Nb and Ti in which it was possible to achieve negative resistance. A formula for the calculation of the value of negative resistance is furnished. As a result of preliminary investigations of dielectric films based on niobium and titanium oxide in strong fields, there were obtained metal-dielectric-metal structures which at a defined voltage had negative resistance. Temperature investigations of the structures showed that section of negative resistance is preserved to a temperature of +140°C in contrast to p-n-p-n silicon devices in which the temperature range for negative resistance is extremely small. Author

N68-37308# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RIBBON CRYSTALS OF SILICON AND THEIR APPLICATION IN MICROELECTRONICS [LENTOCHNYYE KRISTALLY KREMNIYA I NKH PRIMENENIYE V MIKROELEKTRONIKE]
A. V. Sandulova *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 92–97 refs (See N68-37299 23-09)

A method is explained for producing thin ribbon crystals of silicon using gold as the impurity. A study of the ribbon crystals found them to have great photosensitivity suitable for manufacture of photoresistors. Their very small size makes possible using them for microminiaturization of radiotechnical and electronic equipment. Author

N68-37309# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TENSOMETRIC PROPERTIES OF FILIFORM AND NEEDLE-SHAPED SINGLE CRYSTALS OF SILICON [TENZOMETRICHESKIYE SVOYSTVA NITEVIDNYKH I IGOL'CHATYKH MONOKRISTALLOV KREMNIYA]
A. V. Sandulova, I. I. Mar'yamova, and Yu. I. Zaganyach *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 98–103 refs (See N68-37299 23-09)

Summary data are given on the study of tensometric properties of filiform and needle-shaped single crystals of silicon grown through crystallization from gas phase with participation of bromine as a solvent. P-type conductivity in these crystals was created by alloying them in process of growth with boron or aluminum; n-type conductivity was created by alloying with arsenic. The morphology of filiform crystals in thicknesses up to several microns does not differ from that of needle-shaped crystals. Author

N68-37311# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF CONCENTRATION PROFILE OF IMPURITY FROM FORM OF PLANAR P-N JUNCTION [OPREDELENIYE KONTSENTRATSIONNOGO PROFILYA PRIMESI PO FORME PLANARNOGO P-N PEREKHODA]
A. V. Bakuntsev *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 110–112 refs (See N68-37299 23-09)

Inasmuch as the quality of a diffusion p-n junction, in particular, breakdown voltage and capacitance of the junction, depend on the gradient of concentration of impurity at the border of the p-n junction, to find the characteristic of a planar junction, having borders in two planes, it is important to know the distribution of impurity on these planes in material of base. Equations for such a determination are presented. Author

N68-37312# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF VOLT-AMPERE CHARACTERISTICS OF A METAL TO P-SILICON PRESSURE CONTACT (ALPHA PARAMETER) [ISSLEDOVANIYE VOL'T-AMPERNYKH KHARAKTERISTIK PRIZHIMNOGO KONTAKTA METALL-P-KREMNIY (PARAMETR ALPHA)]
V. I. Strikha *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 113–122 refs (See N68-37299 23-09)

Preliminary investigations showed that in diodes with pressure contact, made from sufficiently low-resistance silicon, height of barrier is insufficient for formation of p-n junction and, thus, the processes of rectification are determined by one type of charge carrier and that a large role in rectification is played by the gap between metal and semiconductor. Investigations conducted confirmed the correctness of allowance for only one type of carrier and gap between metal and semiconductor. Furthermore, in this study, proof was obtained in favor of relationship equation for value i_g, indicating that the gap is the determining factor for mechanism of rectification. Details of the method of investigation are provided. Author

N68-37313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF VOLTS-AMPERE CHARACTERISTIC OF A METAL-SEMICONDUCTOR POINT CONTACT WITH ALLOWANCE FOR GAP AND TWO TYPES OF CARRIERS [RASCHET VOL'T-AMPERNOY KHARAKTERISTIKI TOCHECHNOGO KONTAKTA METALL-POLUPROVODNIK S UCHETOM ZAZOVA I DVYKH TIPOV NOSITELEY]
V. I. Strikha *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 123–131 refs (See N68-37299 23-09)

In this study there is taken into account the presence of a gap between metal and semiconductor for the case in which two types of carriers, majority and minority, play a role in rectification. Technical details of the experiment are provided. Author

N68-37319# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF INFLUENCE OF FROZEN VACANCIES ON MICROHARDNESS AND ELECTRICAL RESISTANCE OF FERRITES [ISSLEDOVANIYE VLIYANIYA ZAMOROZHENNYKH VAKANSIY NA MIKROTVERDOST I ELEKTROSOPROTIVLENIYE FERRITOV]

V. N. Danilov and L. I. Shklyaruk *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 160–164 refs (See N68-37299 23-09)

Chemical composition of ferrites renders great influence on their specific electrical resistance. Mechanical properties of ferrites have had insufficient study. Purpose of this work is to study kinetic processes in single- and poly-crystals of ferrites ($NiFe_2O_4$, $Y_3Fe_5O_{12}$) after hardening by method of measurement of microhardness and electrical resistance. A suggested explanation is offered for the observed results. Author

N68-37320# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF QUALITY CONTROL OF TECHNOLOGICAL OPERATIONS IN PROCESS MANUFACTURE OF SEMICONDUCTORS [METOD KONTROLYA KACHESTVA VYPOLNENIYA TEKHNOLOGICHESKIKH OPERATSIY V PROTSESSE IZGOTOVLENIYA POLUPROVODNIKOVYKH PRIBOROV]

A. S. Tarasuta *In its* Semicond. Technol. and Microelectron. 25 Aug. 1968 p 165–168 (See N68-37299 23-09)

A method of quality control is presented. In this method measurement of value of noise and its spectral distribution are used to judge the quality of a technological operation, i.e. to judge the quantity and type of defects introduced or removed by one operation or anpther in the manufacturing process. Formulas for such measurements are included. Author

N68-37325# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

GENERALIZED SUSCEPTIBILITIES AND MAGNETIC ORDERING OF HEAVY RARE EARTHS

William Edwin Evenson (Ph.D. Thesis) May 1968 91 p refs (Contract W-7405-ENG-82)

(IS-T-226) CFSTI: HC $3.00/MF $0.65

The generalized susceptibilities, $\chi(q)$, were calculated for the heavy rare-earth metals, Gd, Dy, Er, and Lu, along the line Γ to A of the Brillouin zone. The matrix elements involved in the susceptibilities were taken to be constants so that the susceptibilities calculated contain only information from the energy bands. To develop a reliable numerical procedure, two sets of energy bands were examined in detail which could be calculated analytically as well as numerically. These bands were chosen to give spherical and cubic Fermi surfaces. The results obtained from them showed how to eliminate any spurious features in the susceptibilities arising from the numerical calculation, and once these spurious features were removed, these special bands demonstrated that the numerical procedures were quite reliable. Author (NSA)

N68-37329 Stanford Univ., Calif.

STUDIES OF MICROWAVE SHEAR WAVES IN SOLIDS

Eric Gung-Hwa Lean (Ph.D. Thesis) 1967 148 p

Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17454

Theoretical and experimental investigation of microwave shear waves in solids were conducted with emphasis on the efficient generation of microwave shear waves and on the theory and applications of the parametric interaction of microwave shear waves and light. Utilizing the unique characteristics of shear wave diffraction, a laser was used as an optical probe to map the energy distribution of shear waves, to measure the attenuation, to estimate the mode conversion efficiency of an yttrium–aluminum garnet (YAG) mode converter, and to determine the reflection and transmission coefficients of shear wave bonds. The second feature of shear wave diffraction was also demonstrated by measuring quantitatively the acoustic birefringence in a [110] oriented YAG rod. This provided a technique to determine experimentally the orientation and ellipticity of shear waves generated from experimental transducers. Dissert. Abstr.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-36348*# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Group.

A STUDY OF ENERGY RELEASE IN ROCKET PROPELLANTS BY A PROJECTILE IMPACT METHOD Annual Report, 10 May 1967–9 May 1968

Andrej Macek and Richard H. Johns May 1968 24 p refs (Contract NAS1-6200)

(NASA-CR-66682) CFSTI: HC $3.00/MF $0.65 CSCL 21I

A new technique has been developed for direct experimental measurement of detailed profiles of shock waves generated by projectile impact. The technique has made possible a clear definition of experimental requirements for generation of square waves in solid propellants. Samples of granular ammonium perchlorate were subjected to square waves of measured durations and amplitudes, and the partly reacted residues were recovered for subsequent chemical analysis. The analytical procedures are discussed in some detail. The resulting data for decomposition of ammonium perchlorate are given as functions both of shock duration (6 to 21 μsec.) and shock amplitudes (5 to 18 kbar). Extents of ClO_4^- decomposition range up to 14% but the extent of decomposition of NH_4^+ never exceeds 3%. A laboratory-type composite propellant was also tested in a series of square wave shock experiments. Threshold amplitudes for explosion were found and are given for several shock durations. Author

N68-36805# Stanford Research Inst., Menlo Park, Calif. Poulter Lab.

THE EFFECT OF INITIAL TEMPERATURE ON THE SHOCK SENSITIVITY OF GRANULAR EXPLOSIVES Annual Report, 5 Aug. 1966–5 Aug. 1967

J. Roth and J. H. Blackburn 28 Aug. 1967 94 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.

(Contract AT(29-1)-789)

(SC-CR-67-2805; AR-1) CFSTI: HC $3.00/MF $0.65

Shock initiation of six granular high explosives was studied at loading density 0.9 of the crystal in a 1/2-in. gap-test geometry. Hexanitrostilbene (HNS) was also studied by the plane-wave wedge technique. The tests were carried out at room temperature and at various preheat temperatures. Preheating sensitized all but one of the explosives to shock. Shocks in granular explosives can, according to the strength of the shock, produce detonation, partial chemical reaction without detonation, or simple compaction of the explosive. Only at very low pressures can the explosives sustain passage of a shock with no permanent effects of any kind. Equation of state data were obtained for all six explosives. These data may be used to predict shock effects and to calculate shock transmission across boundaries in practical explosive devices. Author (NSA)

N68-37363 Bolkow Entwicklungen K. G., Munich (West Germany).

THEORETICAL INVESTIGATION OF LIQUID PROPELLANT SLOSHING IN ROCKET TANKS WITH ROTATIONAL SYMMETRY AND ARBITRARILY PLACED BAFFLES [THEORETISCHE UNTERSUCHUNGEN DES TREIBSTOFFSCHWAPPEE IN ROTATIONSSYMMETRISCHEN RAKETENBEHAELTERN BEI VORHANDENSEIN VON BELIEBIGEN INNENBERANDUNGEN]

Friedrich Pfeiffer 14 Jul. 1967 31 p refs In GERMAN Reprinted

(FM-372-0) CFSTI: $3.00

Frequencies, forces, and natural fuel oscillation moments are computed and used to determine the sloshing mechanics in

rotation-symmetrical rocket tanks of variable inner dimensions and variable filling heights. Theoretical results agree well with obtained measurements. Transl. by G.G.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-36029*# United Aircraft Corp., East Hartford, Conn. Research Labs.
ANALYTICAL STUDY OF CATALYTIC REACTORS FOR HYDRAZINE DECOMPOSITION Annual Progress Report, 15 Apr. 1967–14 Apr. 1968
Arthur S. Kesten May 1968 86 prefs
(Contract NAS7-458)
(NASA-CR-97097; UARL-G-910461-24; APR-2) CFSTI: HC $3.00/MF $0.65 CSCL 21E

A study of reaction chambers was performed to assess the effects on the steady-state behavior of the system of nonuniform radial injection and of catalyst bed configurations exhibiting both radial and axial nonuniformities. Radial variations in mass flow rate or bed packing cause radial temperature and concentration gradients which lead to turbulent diffusion of heat and mass in the reactor system. A computer program was developed to calculate temperature and reactant concentration distributions as functions of axial and radial position in typical hydrazine reaction chambers. The program is based upon a model of the reactor system which includes treatment of the turbulent diffusion of heat and mass in the free-gas phase along with heat and mass diffusion within the catalyst particles and between the particles and the free-gas phase. Both thermal and catalytic decomposition of the reactants are considered. Turbulent diffusion phenomena, the reactor model which treats these phenomena, and typical results calculated on the basis of this model are described. Author

N68-36216# Hydronautics, Inc., Laurel, Md.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF LARGE AMPLITUDE OSCILLATING FOIL PROPULSION SYSTEMS
J. Otto Scherer May 1968 147 p refs
(Contract DA-44-009-AMC-1759(T))
(FTR-662-1; AD-673776)

This report presents an analytical method for computing the forces and moments on a rigid foil of finite span undergoing large amplitude pitching, heaving, and surging oscillations. The influence of foil stall and the induced slipstream are included. Experimental data obtained on a large amplitude oscillating foil propulsor are presented and compared with the theory. Performance predictions for an oscillating foil propulsor for use on a small, 15 knot, shallow-draft boat are also presented. Author (TAB)

N68-36232# Dynasciences Corp., Blue Bell, Pa.
COMPARATIVE PERFORMANCE STUDY OF PROPELLER, DUCTED PROPELLER, AND TURBOFAN PROPULSION SYSTEMS Final Report, Jun. 1966–Oct. 1967
D. S. Douglas, S. Mills, and E. Kisielowski Jun. 1968 167 p refs
(Contract DA-44-177-AMC-437(T))
(DCR-248; USAAVLABS-TR-68-21; AD-673792)

Analytical methods are presented for evaluating performance of open propellers, ducted propellers, and turbofans for the purpose of selecting the most suitable propulsion system for Army aircraft mission requirements. Techniques are presented for tradeoff analyses and optimization of the basic design parameters of each propulsion system. These techniques utilize specially developed nomographs, which can be effectively applied for preliminary design purposes. The nomographs and other numerical results presented in the report are based on the available performance data for the three propulsion systems. Author (TAB)

N68-36507*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTAUR LAUNCH VEHICLE PROPELLANT UTILIZATION SYSTEM
Steven V. Szabo, Jr., James A. Berns, and Andrew J. Stofan Washington Oct. 1968 35 p refs
(NASA-TN-D-4848) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The development history, configuration, and operation of the Centaur propellant utilization system is described. The system used capacitance mass sensors to sense boiling liquid oxygen and liquid hydrogen in the propellant tanks. The system electronics utilized signal levels in the nanoampere range for control. The system operation was verified on nine Atlas-Centaur flights; end propellant residuals were controlled to less than 20 kilograms of liquid hydrogen out of a total tanked propellant weight of 13 600 kilograms. Author

N68-36512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY TESTS OF A SINGLE-AXIS AMMONIA-RESISTOJET ATTITUDE CONTROL SYSTEM
Harold Ferguson, James S. Sovey, and Henry R. Hunczak Washington Oct. 1968 16 p refs
(NASA-TM-X-1677) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Performance data are presented for an ammonia-resistojet attitude control system designed for use with stable platform type satellites in the 225- to 450-kg class. The system includes the fast-heatup thrusters (2 mN thrust), propellant storage and feed components, control logic, and power and signal conditioning. The ability of the system to acquire and maintain a soft limit cycle control mode within an attitude accuracy of ±0.2° was demonstrated. In particular, thruster performance was obtained which indicated that increased preheat time and pulse width cause significant decreases in propellant mass flow rate and thrust and an increase in specific impulse. Author

N68-36515*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF THRUST PER ELEMENT ON COMBUSTION STABILITY CHARACTERISTICS OF HYDROGEN OXYGEN ROCKET ENGINES
Reino J. Salmi, John P. Wanhainen, and Ned P. Hannum Washington Oct. 1968 30 p refs
(NASA-TN-D-4851) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The results obtained with a series of 10.78-inch (0.27-m) coaxial INJECTORS ON A -))))-pound (88 964-N) thrust oxygen-hydrogen rocket engine operated at a chamber pressure of 300 psia (2.084 MN/m^2) were analyzed to determine the effects of injector thrust per element T/E on the combustion stability. The thrust per element ranged from about 20 to 2500 pounds (88.96 to 11 120 N). Based on the minimum hydrogen temperature for stable combustion, the combustion stability increased with increasing thrust per element. No combustion instability was observed at a thrust per element of 200 pounds (889.6 N) or above. Bombing of the 572 and 1000 pound (2542 and 4448 N) T/E injectors failed to induce combustion instability. The hydrogen transition temperatures of the unstable injectors showed agreement with two different correlating parameters. Author

N68-36817*# Northern Research and Engineering Corp., Cambridge, Mass.
ANALYSIS OF GEOMETRY AND DESIGN POINT PERFORMANCE OF AXIAL FLOW TURBINES. PART 2: COMPUTER PROGRAM
M. Platt and A. F. Carter Washington NASA Oct. 1968 319 p refs
(Contract NAS3-9418)
(NASA-CR-1187) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The computer program which has been developed to solve the equations governing flow in an axial turbine is examined. A complete description of the program, an indication of its usage, and sample results obtained from the program are included. The computer program follows directly from the analysis and the loss coefficient correlation which were developed previously. The program can be used to analytically investigate the effects of changes in the design variables. The variables include: number of stages, annulus geometry, work distribution, stage work split, radial distribution of stator exit whirl velocity or flow angle, radial variations of the meridional components of streamline slope and curvature, and blade element loss characteristics when values other than the internally computed total pressure loss coefficients are considered necessary for the analysis. The coefficients of the total pressure loss coefficient correlations are also input items and, therefore, can be used as analysis variables. Author

N68-36624*# Bendix Corp., Southfield, Mich. Research Labs.
RESEARCH AND DEVELOPMENT OF A VORTEX VALVE CONTROLLED HOT GAS (5500°F) SECONDARY INJECTION THRUST VECTOR CONTROL SYSTEM
T. W. Keranen and A. Blatter Sep. 1968 62 p refs
(Contract NAS1-5199)
(NASA-CR-66692; BRL-4455) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This program resulted in the successful demonstration of a vortex valve controlled secondary injection thrust vector control (SITVC) system on a solid propellant rocket motor. These valves have the capability of modulating a 750 psia, 1 lb/sec flow of 16% aluminized, 5500°F solid propellant gas, with a demonstrated operating time of 50 seconds. The SITVC system consisted of a pilot stage which provided push-pull control of two SITVC hot gas vortex valves. The pilot stage contained a torque motor powered flapper-nozzle valve which, in turn, controlled two vortex amplifier valves. A 2000°F solid propellant gas generator (SPGG) supplied gas to the pilot stage. The two SITVC vortec valves were installed on the horizontally positioned EM-72 rocket, such that one valve injected in the engine thrust nozzle vertical plane and the other in the horizontal plane. The results of the hot gas tests showed that the vortex valve controlled SITVC System produced side forces up to 4% of the main engine thrust. The SITVC System materials and structure were able to control and handle the flow of aluminized 5500°F gas for over 50 seconds with little component degradation. Author

N68-36641*# TRW Systems Group, Redondo Beach, Calif. Power Systems Div.
PRODUCING HOLOGRAMS OF REACTING SPRAYS IN LIQUID PROPELLANT ROCKET ENGINES, PHASE 2 Interim Report, 3 Apr.–2 May 1968
R. F. Wuerker and B. J. Matthews 24 May 1968 54 p ref Prepared for JPL
(Contracts NAS7-100; JPL-952023)
(NASA-CR-97225; TRW-68-4712-2-020) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Pulsed ruby laser transmission holograms were recorded of the hypergolic combustion of N_2O_4/N_2H_4–UDMH and FNA–UDMH within 3" i.d. rocket engines with transparent walls. Fifty separate engine firings were made varying propellant temperatures, pressures, nozzle diameters, holocamera scene-reference beam ratios, etc. Two direct laser illuminated photographs were taken of an open flame test, and one hologram of open flame combustion. The feasibility of making holograms was demonstrated. Additional conclusions reached were:(1) The severe attenuation of the 0.69 μ ruby illumination light was shown by the combustion processes in 3" i.d. engines and propellant flow rates of 0.3 to 1.0 lb/sec. (2) Holograms could be recorded by increasing the scene and reference beam ratios to compensate for the scene beam attenuation. (3) The acrylic engine walls were eroded by the oxidizer. (4) Superiority was demonstrated of Pyrex over acrylic walls to resist thermal and corrosive attack by the combustion process. B.P.

N68-36658*# Hughes Research Labs., Malibu, Calif.
HIGH-TEMPERATURE LM CATHODE ION THRUSTERS Quarterly Progress Report, 5 May–4 Aug. 1968
J. Hyman, Jr., W. O. Eckhardt, and J. A. Snyder 15 Aug. 1968 48 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952131)
(NASA-CR-97210; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A 20-cm electron-bombardment thruster with a high-temperature LM cathode was operated with a beam current $I_B \approx 600$ mA at a specific impulse $I_{sp} = 6,200$ sec. Total source energy per ion $V_S = 260$ eV/ion was measured at a mass utilization efficiency $\eta_m = 80\%$. (V_S includes all power to form the ions, because no vaporizer, cathode heater, or keeper power is required with the LM cathode.) Operation at $I_{sp} = 4,400$ sec resulted in 50 eV/ion increase in discharge-chamber losses. Fabrication of a thermally integrated 30-cm thruster is complete and assembly has begun. Satisfactory operation has been demonstrated with both annular and linear-slit cathodes which utilize a 2.5 μm tantalum shim to establish the narrow feed channel. The annular cathode operated satisfactorily in the 20-cm thruster at a temperature sufficiently high (200°C) to permit radiant cathode cooling. An LM cathode neutralizer in which the arc-spot pattern is always located on non-permanently-wettable material performed satisfactorily. LM cathode operation has been demonstrated under conditions of high-voltage isolation. Author

N68-36737*# TRW Systems Group, Redondo Beach, Calif.
PRODUCING HOLOGRAMS OF REACTING SPRAYS IN LIQUID PROPELLANT ROCKET ENGINES Final Report
R. F. Werker, B. J. Matthews, and R. A. Brionas 31 Jul. 1968 117 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952023)
(NASA-CR-97209; TRW-68-4712-2-024) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Holograms and laser-illuminated photographs were recorded of water sprays and of two different propellant combinations: (1) N_2O_4 and a 50 wt % blend of N_2H_4 and unsymmetrical dimenthyhydrazine (UDMH); and (2) fuming nitric acid and UDMH. A unique two-beam, pulsed ruby laser holocamera was constructed and tested. Water spray and open flame holograms were recorded to confirm the feasibility of using this technique in combustion studies. A single element impinging stream injector was used for all atmospheric water flow and reacting spray tests. Tests were conducted at ambient and elevated temperatures. The holography of single element injector sprays reacting in 3-in-diam acrylic thrust chambers was investigated. A window 18-in-diam thrust chamber and multiple element impinging stream injector were used in confined combustion tests. Various scene reference beam ratios were studied to overcome attenuation of the scene light by the combustion. Chamber window construction experiments were performed to minimize erosion of internal chamber surfaces from the combustion. K.W.

N68-37185# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
ACCEPTABILITY OF STAGE SEPARATION DEVICES [QUALIFICATION DES SEPARATIONS D'ETAGES SPATIAUX]

Roger Marguet and Jean Trichard 1968 18 p In FRENCH Presented at the Intern. Colloq. on the Util. of Pyrotech. and Explosive Elem. in the Spatial System, Tarbes, France, 9–12 Jul. 1968
(ONERA-TP-615) CFSTI: HC $3.00/MF $0.65

With the aim to define the acceptability of stage separation devices, a series of tests under different roll velocity conditions has been carried out. This study leads to the acceptance of pyrotechnical devices best suitable for this function, to analyze perturbation causes and to emphasize the qualities of exploding wires. The experimental equipment and its measuring instruments are described and results are applied to ONERA's scientific missiles TIBERE/ELECTRE and TACITE. ESRO

N68-37264*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE STAGE TURBINE SUITABLE FOR AIR COOLING. 4: STATOR OVERALL PERFORMANCE WITH 70 PERCENT DESIGN AREA
Frank P. Behning, Bernard Bider, and Edward M. Szanca Washington Oct. 1968 18 p refs
(NASA-TM-X-1675) CFSTI: HC $3.00/MF $0.65 CSCL 21E

A program is being conducted to study a single stage turbine at stator area settings of 70, 100, and 130 percent of design. This report presents the overall stator performance at the closed setting and compares the results with those obtained from design tests. Results are presented in terms of mass flow, outlet flow angle, and blade surface static pressure and velocity distributions, as well as inner- and outer-wall static pressures as obtained over a range of stator pressure ratios. Author

N68-37334 Aerodynamische Versuchsanstalt, Gottingen (West Germany).
CALCULATION OF AXIALLY SYMMETRICAL INTAKE CONTOURS BY MEANS OF THE SINGULARITY METHOD [BERECHNUNG ROTATIONSSYMMETRISCHER EINLAUF-KONTUREN MIT HILFE DER SINGULARITAETENMETHODE]
Wolfgang Geissler 5 Feb. 1967 49 p refs In GERMAN
(Rept.-62-A-12)

A computer program was developed and used to calculate rotation-symmetrical intake contours forming through superpositioning of vortex rings on parallel flow. Iteration of a semi-finite cylindrical vortex model, formed by eddy distribution, determined the eddy current of the resulting flow field. Thus, the eddy surface was represented by a continuous vortex ring distribution. Author

N68-37411# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID PROPULSION
In its Space Programs Sum. No. 37–51, Vol. 3 30 Jun. 1968 p 137–141 refs (See N68-37397 23-11)

Reported are results of the last part of a series of patch-type tests of an expulsion bladder material for the thermal sterilization compatibility study. The bladder material tested was ethylene-propylene rubber (EPR). The reported series of tests included determination of parameters for Shore A hardness of the patch test samples, the permeation rate of the samples to hydrazine, and the degradation of the hydrazine resulting from heat sterilization cycling. These parameters were plotted as a function of the number of heat sterilization cycles. Data indicate a slight increase in permeation rates with an increasing number of heat sterilization cycles. Also an appreciable degradation of the hydrazine occurred during the first heat sterilization cycle. Included are results of studies of temperature sensitivity of EPR patch test samples immersed in hydrazine, and results of chemical analyses of remaining hydrazine after heat sterilization. Based on results of this series of tests, it is concluded that the ethylene propylene material is very marginal for expulsion use with hydrazine at a temperature level of 275° F. S.C.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-36131*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THE FLUCTUATION ORIGIN OF COSMIC RADIATION
J. R. Wayland Aug. 1968 21 p refs
(Grant NGL-21-002-033)
(NASA-CR-97142; TR-873) CFSTI: HC $3.00/MF $0.65 CSCL 20H

We have investigated the origin of cosmic radiation in terms of a sudden injection of particles in time, momentum and space. The appropriate boundary conditions for the various regions through which the particles pass were used. With all of the acceleration within a turbulent region, we find that the observed spectrum is explained by a continuous deceleration in which statistical fluctuations dominate. This is contradictory to the usual assumptions in which fluctuation do not play an important part. We find that the exponent of the power law spectrum has a weak momentum dependency as $\gamma = 0.057 \ln (P/P_0) + 0.67$. Author

N68-36374 California Inst. of Tech., Pasadena.
THE SOLAR WIND AND ITS ANGULAR MOMENTUM
Edmund John Weber (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17079

A steady state model is developed for the solar wind in the equatorial plane. Included in the equation of motion are forces due to gravity, viscosity, pressure gradients and magnetic fields. The electrical conductivity of this plasma is taken to be infinite. Since it is impossible to determine the qualitative features of the solar wind motion from a study of the complete set of equations, a simplified model is treated at first. This model has an isotropic pressure, no viscosity and an energy supply characterized by a polytrope law. It is found that the solution of the radial motion must pass through three critical points, whose significance is explained in terms of the characteristic velocities with which small amplitude disturbances propagate. Similarly, the solution of the azimuthal motion has to pass through the radial Alfvénic critical point where the radial Alfvénic Mach number equals unity. The conditions at this point together with the solution of the radial motion then determines uniquely the values of the azimuthal velocity and the magnetic field everwhere, in particular at the surface of the sun. A numerical solution is obtained for typical parameters. Dissert. Abstr.

N68-36519# Sacramento Peak Observatory, Sunspot, N. Mex.
ESTIMATING THE RELIABILITY OF LIMB DARKENING FUNCTIONS AND SOURCE FUNCTIONS OBTAINED BY LINEAR LEAST SQUARES FITTING
O. R. White 25 Jun. 1968 39 p refs Prepared in cooperation with Hawaii Univ. *Its* Solar Res. Note No. 26
(Contract AF 19(628)-5086)
(AD-673383)

One of the most commonly-used methods for inverting the emergent intensity integral, I(mu) = the integral from 0 to infinity of the quantity (S(tau) exp(-tau/mu)(d tau)/mu), is to fit the data I(mu sub i) with a function for which the Laplace transform is known. Polynomials in mu and ln mu are most convenient because they require only linear least squares fitting of the data. However, such polynomials often lead to physically inadmissable values of S(tau) for the limiting values of tau approaching 0 and tau approaching infinity. So, the question of the range and degree of reliability for such a source function is of interest. Such questions lead directly to error propagation in least squares processes and also to the concept of the weight or error band of a fitted curve.

This note discusses the inverse matrix in least squares problems where one variable is known precisely. Author (TAB)

N68-36551# Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 188 12 Sep. 1968 p 1-9 refs (See N68-36550 23-13)

Reviews of recent Soviet literature in the field of astronomy are presented in abstract form. The origins of cosmic rays and their detection are discussed. Articles which deal with lunar topics include: heat flux variations on the lunar surface illuminated by the sun; electrophotometric observations of the spectra of lunar features; experimental model simulation of the features in lunar walled plains; mechanism of lava formation in the lunar seas; hypothesis explaining peculiarities in rotation and revolution of the moon; and suggestions for a unified system of abbreviations for names of lunar features. Radiant heat transfer, dependence of molecular conduction on temperature, pressure, melting point, and heat of fusion are considered in evolving the thermal history of the Moon and Mars. Color comparison of Mars with terrestrial objects was made using a telescope. Spectral studies of the Mars atmosphere and radio emission measurements of Mercury are presented. Rapid changes in the intensity of radio emission from small angular dimensional sources are reported. A book on the history of telescopes, development of astronomical optics, and astronomical discoveries is reviewed. B.P.

N68-36574*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
COSMIC RAY GROUP
In its Phys. 1 Oct. 1967 p 1-9 refs (See N68-36573 23-24)

An overview is presented on the research conducted in the area of X-ray astronomy. Balloon-borne experiments included a general survey of the northern sky which was carried out using a 400 cm^2 NaI telescope, and an assessment of instruments developed to obtain higher sensitivity and better spectral resolution. Satellite and rocket probes are mentioned. Summary information is included on the data analysis of plasma experiments carried on the OGO-1, OGO-3, Mariner 4, Pioneer 6, Pioneer 8, Mariner 5, Explorer 33, and Explorer 35. Theoretical studies are reported on the properties of an anisotropic plasma, solar wind fluctuations, and geophysical phenomena. The air shower program is reviewed in terms of the Cerenkov light experiment, and nuclear burst data. M.G. J.

N68-36603*# California Inst. of Tech., Pasadena.
THE SOLAR FLARES OF AUGUST 28 AND 30, 1966
Harold Zirin and Dora R. Lackner [1968] 34 p refs
(Grant NGR-05-002-034; Contract N00014-67-C-0140)
(NASA-CR-97019; TR-1; AD-672330) CFSTI: HC $3.00/MF $0.65 CSCL 03B

We describe observations of the class 3+ flare of August 28, 1966, made at the Mount Wilson Observatory. This great proton flare followed the sequence: (1) Precursor flare; (2) Filament eruption; (3) Beginning in penumbra of large spot; (4) Rapid elongation in two strands; (5) Great spray and surface wave; (6) Rapid separation of two strands to maximum brightness; and (7) Slow speed of brightness and decay. TAB

N68-36880# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
LOW ENERGY SOLAR COSMIC RAY LATITUDE INTENSITY STRUCTURE AND PITCH ANGLE DISTRIBUTIONS AT LOW ALTITUDE Research Report, Jul. 1965-Dec. 1967
J. B. Blake, G. A. Paulikas, and S. C. Freden Mar. 1968 32 p refs
(Contract F04695-67-C-0158)
(TR-0158-3260-208; SAMSO-TR-68-282; AD-673475)

Solar protons (1.1 - 1.6 MeV) and alpha particles (4.1 - 15 MeV) were observed over the polar caps associated with the proton event of 28 August 1966. Persistent latitudinal structure in the proton flux was observed. Ordering of the structure by magnetic latitude over both polar caps during a given orbit shows that it is a spatial effect associated with non-uniform access of solar protons to high latitudes. Examples of the latitudinal structure are shown. Pitch angle distributions were observed, which clearly delineated a region of quasi-trapping; the changes in the pitch angle distributions during a representative pass as the spacecraft, 1966-70A, traversed the region of quasi-trapping are shown. No evidence for the durable containment of the quasi-trapped solar alpha particles was observed. Author (TAB)

N68-36900*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COSMIC GAMMA-RAYS FROM METAGALACTIC PROTON-ANTIPROTON ANNIHILATION
F. W. Stecker Oct. 1968 17 p refs
(NASA-TM-X-63368; X-641-68-390) CFSTI: HC $3.00/MF $0.65 CSCL 20H

It is shown that annihilation gamma radiation has a characteristic spectrum which distinguishes it from other types of cosmic gamma radiation. Such spectra are presented, based on the results of accelerator experiments on antiproton annihilation and also including cosmological distortions of local annihilation-gamma-ray spectra. Using the baryon inhomogeneity cosmology, it may be possible to account for both the observed cosmic isotropic X-rays and gamma rays as due to red-shifted annihilation-gamma-radiation where the mean value of the product of interacting matter and antimatter densities is of the order of 10^{-18} cm^{-6}. Author

N68-37157# Oslo Univ. (Norway).
ON COORDINATE SYSTEMS FOR DESCRIBING THE POSITION OF SOLAR ATMOSPHERIC FEATURES
Einar Haugen 1968 27 p refs
(NP-17530; Rept.-25)

The formulae for transformation from a set of observable coordinates of solar features to two sets of spotcentric coordinates are given. A set of approximate formulae are given for the same coordinate transformations. The values of the two sets of exact coordinates were computed for a grid of observed-coordinate values, and compared with the corresponding values given by the approximate formulae. Author (NSA)

N68-37169# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
A NEW PROCESS IN ULTRA HIGH ENERGY INTERACTIONS
E. Lohrmann Jun. 1968 8 p refs
(DESY-68/32)

It is shown that the results of two high energy cosmic ray experiments can be correlated and lend mutual support to the indication that a new mechanism leading to the copious production of ϕ-mesons starts above 10^{12} eV. Further possible experiments to see this effect are discussed. Author (NSA)

N68-37178# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
SOLAR PHYSICS [LA PHYSIQUE SOLAIRE]
Daniel Berthier (Ph.D. Thesis--Grenoble Univ.) Jun. 1968 32 p refs In FRENCH; ENGLISH summary
(CEA-BIB-121) CFSTI: HC $3.00/MF $0.65

The essential theories put forward of the solar mechanism are presented, particular emphasis is made on the transfer of the energy from the central nucleus where it is produced up to the most external zones. In the nucleus, characterized by high densities and high temperatures, thermonuclear reactions are produced where hydrogen is transformed into helium. The photosphere, the visible part of the solar disc, is the zone that emits the greatest part of

luminous energy. The chromosphere and the corona, the sun's most external strata, are the zones where solar activity manifestations are very intense. An important bibliography concerning the chief theories of the subject is added. Author (ESRO)

N68-37221# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OBSERVATIONS OF CHROMOSPHERIC SPICULES IN THE H_β AND HE I 3888.65 Å LINES
K. I. Nikolskaya 30 Aug. 1968 9 p refs Transl. into ENGLISH from Soln. Dannye (USSR), no. 5, 1967 p 88–92
(SAO-804-150)

Spectra of chromospheric spicules near H_β, photographed during August 1966, were compared with simultaneous photographs of spicules in the H_β and He I 3888.65 Å lines. Brightness of the helium and hydrogen lines were found to change equally from spicule to spicule; although direct examination of the spectrograms did not permit conclusions of the coincidence of the H and He spicules. Because they are so close, the H and He spicules look like a single formation. Radiation of the He I lines may arise in regions whose kinetic temperatures do not exceed 10,000°K. If it is assumed that the nonthermal velocities of the H and He regions in separate spicules are equal, the kinetic temperatures of spicules should be less than 15,000°K. The nonthermal velocities calculated from equal kinetic temperatures in the H and He spicules are almost indistinguishable at 6000°K. M.W.R.

N68-37233*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SURVIVAL OF HEAVY NUCLEI IN COLGATE'S SUPERNOVA COSMIC RAY ACCELERATION MODEL
James H. Kinsey Sep. 1968 29 p refs
(Grant NsG-695)
(NASA-TM-X-63363; X-611-68-352) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The supernova acceleration model for cosmic rays of Colgate is examined to see if heavy nuclei can indeed survive catastrophic acceleration. If it is assumed that all species of nuclei are collectively accelerated by a mechanism such as a plasma wave instability in a shock wave, then the only agent remaining to dissociate heavy nuclei in Colgate's model is the blue shifted photon flux in the radially outward moving shock wave. This would cause a sharp cutoff of the heavy component of cosmic rays from photodisintegration for cosmic ray energies greater than 10^3 GeV/nucleon. Author

N68-37235*# New Hampshire Univ., Durham. Physics Dept.
GAMMA RAY PRODUCTION IN PARAFFIN BY COSMIC RAYS
E. L. Chupp, D. J. Forrest, and P. J. Lavakare Sep. 1968 15 p refs
(Grant NGR-30-002-021)
(NASA-CR-97253; UNH-68-9) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Gamma ray production was measured at balloon altitudes in large paraffin blocks surrounding a central gamma ray detector. This shielding was considered for use with detectors in balloon solar gamma ray astronomy for the 0.2 to 4.0 MeV region. Four boxes of household paraffin were arranged so they could be removed from proximity to the central detectory by a radio command. The gamma ray pulse height spectrum was recorded with and without paraffin shielding. Study of respective counting rates showed the paraffin acting as an absorber of the ambient gamma ray spectrum by decreasing the counting rate and local gamma ray production from capture and scattering of ambient neutrons in the paraffin which enhances the counting rate at an observable peak at 2.22 MeV. D.H.B.

N68-37328 Physical Research Lab., Ahmedabad (India).
ANISOTROPIES OF GALACTIC COSMIC RAYS IN THE SOLAR SYSTEM
D. Patel, Vikram Sarabhai, and G. Subramanian [1968] 34 p refs Supported by India. Dept. of Atomic Energy Submitted for publication
CFSTI: $3.00

At least four processes appear capable of contributing to the creation of an anisotropy of galactic cosmic rays in interplanetary space. All need not necessarily be active on a particular day to the same extent. The processes are (1) azimuthal streaming, (2) streaming due to non-uniform diffusion in a longitudinal sector structure, (3) the scattering at irregularities along the interplanetary magnetic field, and (4) latitudinal gradients in relatively smooth magnetic field, and (4) latitudinal gradients in relatively smooth magnetic field. The characteristics of the daily variation which must be expected from each process are quantitatively evaluated. Observational evidence derived from measurements of the daily variation from a net work of super neutron monitors is used to derive with precision, the spectrum of variation, the amplitude and the principal direction of maximum and minimum intensity in interplanetary space, on each day during 1964–65. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-36077*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SEMIGRAPHICAL METHOD FOR A DEORBIT TRAJECTORY DESIGN STUDY
Richard N. Green, William F. Hampshire II, and Sue W. Souders Washington Oct. 1968 25 p
(NASA-TN-D-4801) CFSTI: HC $3.00/MF $0.65 CSCL 20C

A semigraphical method to aid in the selection of a deorbit trajectory which is compatible with arbitrarily selected mission constraints is presented. The method is applicable to the case where the initial orbit about the planet and the deorbit trajectory are coplanar. Basically, the method consists of examining a family of candidate trajectories and eliminating, by a graphical cross plotting technique, those which violate the mission constraints. In addition, the trade offs which exist between the various demands on the trajectory become graphically obvious. The method is flexible in that the user is free to dictate the mission mode and the mission constraints. An example illustrating the use of the method for a Mars mission is presented. Author

N68-36103 Michigan Univ., Ann Arbor.
DIRECT METHODS FOR DISCRETE VARIABLE APPROXIMATION TO OPTIMAL FLIGHT PATHS
Bion Lee Pierson 1967 139 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-17827

A set of values is sought that approximates the optimal solution only at discrete time points and not an approximate solution over a continuous time interval. The term direct methods is used because the necessary conditions of the variational theory are not employed. Conjugate direction methods are particularly attractive for the unconstrained minimizations since they offer quadratic terminal convergence without requiring the calculation of second partial derivatives. Two such methods are investigated; each requires a linear minimization at each step of the iteration. Three linear minimization schemes are studied. The example problems are selected to demonstrate the various capabilities of the method. In particular, two problems involving state space constraints are solved. Dissert. Abstr.

N68-36111# Martin Co., Denver, Colo.
NOTES ON MARTIAN SANDSTORMS
Jerold M. Bidwell Sep. 1968 37 p refs
(Rept.-1610-68-34)

If strong surface winds truly exist on Mars, blowing sand may be an important geophysical phenomena. Its importance is both scientific and technological. The mechanisms of blowing sand and dust on Earth are described and experimental studies are conceptually proposed to increase our understanding of blowing sand phenomena and to prepare us to correctly interpret its manifestation on Mars. Author

N68-36138 Michigan Univ., Ann Arbor.
MOTION AND STABILITY OF A SPINNING CABLE-CONNECTED SYSTEM IN ORBIT
Steven Alan Crist. (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.90/Microfilm $3.00 Order No. 67-17744

The specific system analyzed consists of a heavy point mass moving in an undisturbed Keplerian orbit. Spinning in the orbital plane about the heavy mass is a smaller mass which is connected to it by a long thin cable. Hamilton's principle is applied and the exact nonlinear system of partial differential equations for planar motion is derived. The linearized form of these equations are derived and solved for the case of a nonspinning system in an infinite radius orbit with a fixed, constant tension applied to the cable, and for the system spinning in an infinite orbit. It is shown that by approximating the connecting cable by point masses connected by linear elastic springs, the equations of motion via Lagrange's method are a system of nonlinear ordinary differential equations; by linearizing the equations, a system of forced, ordinary differential equations with periodic coefficients results. It is concluded that complex cable connected structures can only be analyzed by modeling the cable as a series of point masses connected by linear elastic, massless springs. Dissert. Abstr.

N68-36141#
ROTATION OF A SATELLITE IN THE ORBIT PLANE BY UTILIZING A FLYWHEEL SYSTEM
N. A. Sadov 18 Sep. 1967 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 4, 1968 p 515–523
CFSTI: HC $3.00/MF $0.65

The problem of rotating a dynamically nonsymmetric satellite from one stable equilibrium position into another by utilizing a flywheel system is considered. The rotation is performed in the plane of a circular orbit. The solution of this problem, found numerically, is approximated well in cases of practical importance, by the asymptotic formulas derived. Author

N68-36142#
ON THE SELECTION OF OPTIMAL MEASUREMENT PARAMETERS
N. S. Tumashev [1968] 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 4, 1968 p 494–501
CFSTI: HC $3.00/MF $0.65

In processing observations the question arises of selecting the parameters characterizing the composition of the measurements. Equations are obtained which govern the optimal values of the parameters for some cases of constraints imposed on the measured quantities. In particular, in determining some orbit elements of a spacecraft by means of measurements between a central body, the vehicle, and stars, optimum directions to these stars are obtained for any number of measurements. Author

N68-36184*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEOS 1 ORBITAL ELEMENTS AND OBSERVATIONS
Beatrice R. Miller and Peter J. Caliri *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 151–326 refs (See N68-36174 23-13)

Mean orbital elements of Geos 1 were derived by use of the precisely reduced observations of Geos 1 and the Smithsonian Astrophysical Observatory's (SAO) Differential Orbit Improvement Program written for the CDC 6400 computer. The precisely reduced observations of Geos 1 are presented as a combination of passive, flash, and range observations taken by the Baker–Nunn cameras, the SAO K-50 cameras, and the SAO laser at Organ Pass, New Mexico. Author

N68-36185*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
LONG-ARC ORBITAL ANALYSIS OF GEOS 1
E. M. Gaposchkin and Paul D. Hubley *In its* Geodetic Satellite Results During 1967 29 Dec. 1967 p 327–344 refs (See N68-36174 23-13)

Numerical results are presented for Geos 1 orbital elements computed for 30-day arcs based on Baker–Nunn and laser observations. Such long-arc orbitals are considered sufficiently accurate for geodetic purposes. Author

N68-36218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MOTION OF A BODY OF VARIABLE MASS WITH ACCUMULATION OF ENERGY AND AN ENGINE WITH RESTRICTED JET DISCHARGE VELOCITY. PART 2
G. L. Grodzovskii and B. N. Kiforenko 14 Sep. 1967 9 p refs Transl. into ENGLISH from the Publ. "O Dvizhenii Tela Peremennoy Massy s Nakopleniyem Energii i Dvizhitelem s Ograhichennoy Skorost'yu Istecheniya Reaktivnoy Strui. Chast' 2" USSR, 1966 p 1–5
(FTD-HT-67-324; AD-673782)

The article considers the variational problem of the optimum motion in a gravitational field (the useful-load maximum) with an engine system of limited power in conjunction with an energy accumulator and an engine of limited exhaust velocity. The general properties are determined for optimum motion exhibiting the indicated limitations. It is demonstrated that an optimum trajectory may be made up of those segments of motion with optimum variations in exhaust velocity, the intervals at which the exhaust velocity is equal to its limit value, as well as of passive segments. TAB

N68-36224 Temple Univ., Philadelphia, Pa.
THE OBSERVATION AND ANALYSIS OF DIFFRACTION EFFECTS IN THE LUNAR OCCULTATIONS OF STARS
Mahendra Punsiri Wijesinghe (Ph.D. Thesis) 1966 384 p
Available from Univ. Microfilms: HC $17.35/Microfilm $4.90 Order No. 67-3224

The diffraction pattern produced when a star is occulted by the moon depends on the extension and distribution of brightness of the star, as well as the size and shape of irregularities that may be present along the moon's limb. In the present study, the intensity is derived in terms of the minimum number of irreducible parameters that can satisfactorily represent the the occultation as seen from a fixed location on earth. The contributions originating from the properties of the star may be expressed in terms of two parameters θ and σ, where θ is a reduced angular diameter which includes the primary effects of limb darkening, wavelength of light, the earth–moon distance and the true angular diameter of the star, while σ is a paramater that depends only on the limb darkening coefficient and is used to express the secondary effects of limb darkening. Three additional parameters are required to express the effects of lunar limb irregularities. Dissert. Abstr.

N68-36239*# National Aeronautics and Space Administration. Goddard Inst. for Studies, New York

ON THE PULSATION HYPOTHESIS FOR MASSIVE RED SUPERGIANTS

Richard Stothers [1968] 17 p refs

(NASA-TM-X-61284) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The fundamental mode of radial pulsation has been calculated for convective envelopes in adiabatic equilibrium, including radiation pressure. The theoretical Q values are compared with the observational Q values of variable M supergiants in galactic associations. The variability of these massive red supergiants can be explained on the pulsation hypothesis if a suitable readjustment of some of the observed periods is made. Pulsation seems to be suggested by: (1) the cyclical variations in magnitude, spectrum, and radius in individual stars; (2) a period-luminosity relation; and (3) a period-spectrum relation for the group of stars. Author

N68-36240*# IIT Research Inst., Chicago, Ill. Technology Center.

COMPOSITIONAL ANALYSIS OF LUNAR AND PLANETARY SURFACES USING NEUTRON CAPTURE GAMMA RAYS Annual Report, 1 Jul. 1967–30 Jun. 1968

John H. Reed and John W. Mandler Aug. 1968 84 p refs

(Contract NASr-65(18))

(NASA-CR-97124; IITRI-V6032-9) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Capture gamma-ray and cyclic activation spectra from large granite and basalt models were obtained using a pulsed 14-MeV neutron source. Gamma rays from iron, silicon, oxygen, sodium, hydrogen (basalt only), aluminum (granite only), titanium (basalt only), and calcium (basalt only) were detected from these materials using a 3 in. × 3 in. NaI(Tl) detector. Inelastic neutron spectra were obtained with and without the use of a neutron reflector to establish the compatibility of the inelastic and capture techniques. The development of computer codes to aid in the analysis of complex high energy gamma-ray spectra was initiated. GAUSS, a computer code, was modified to enable the code to determine the intensities of high energy gamma-ray lines. The modified program, GAUST, was tested on gamma-ray lines from 1.78 to 7.6 MeV and is currently being used to measure the intensity of gamma lines from iron, oxygen and hydrogen. A study of a high resolution Ge(Li) detector is presented. Author

N68-36242 Purdue Univ., Lafayette, Ind.

SHOCK EFFECTS IN AND THE ORIGIN OF IRON METEORITES

Ralph Roger Jaeger (Ph.D. Thesis) 1967 206 p

Available from Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 67-16660

The results of a microscopic and x ray diffraction study of shock effects in 65 octahedrites are reported. These meteorites have, for the most part, been dated by the K^{40}/K^{41} method and have been classified by their Ga–Ge contents. Of the 46 dated specimens, 21 have been shocked to pressures above 130 kb. The age distribution of the shocked and unshocked octahedrites is significantly different, with the shocked meteorites having an age of 400–800 million years. A number of conclusions have been reached. First, a significant percentage of all iron meteorites have been shocked to above 130 kb during preterrestrial collisions. Second, a single collision 645 ± 70 million years ago was responsible for most of the shocked meteorites. Third, the Ga–Ge contents of the iron portion of at least one of the colliding asteroids corresponded to those of group III. Fourth, the composition of the other asteroid was probably similar to that of the hypersthene chondrites. Fifth, the collision resulted in the ejection of iron meteoroids into Mars-crossing orbits. Subsequent perturbations by Mars resulted in the continuous ejection of material into Earth-crossing orbits. Dissert. Abstr.

N68-36287*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

AN INTERPRETATION OF THE PECULIAR HELIUM STAR HZ 29

Richard Stothers [1968] 11 p refs

(NASA-TM-X-61283) CFSTI: HC $3.00/MF $0.65 CSCL 03B

It is suggested that the variability of the peculiar helium star HZ 29 is due to nuclear-energized pulsations in a star of 7–8 $M_\odot$ on the "helium-burning main sequence." Author

N68-36321*# National Aeronautics and Space Administration, Washington, D. C.

OPTIMIZATION OF THE EXTRA-ATMOSPHERIC PART OF THE ASCENDING TRAJECTORY TO AN ORBIT [OPTIMISATION DE LA PHASE EXTRA-ATMOSPHERIQUE DE LA MONTEE EN ORBITE]

Christian Marchal Sep. 1968 58 p refs Transl. into ENGLISH of ONERA (Chatillon, France), no. 560, 1968 34 p

(NASA-TT-F-11878) CFSTI: HC $3.00/MF $0.65 CSCL 22C

For today's high thrust rockets (necessary for orbiting) the minimum expense of propellant is obtained by the use of minimum characteristic velocity solutions. When impulses are allowed, optimal ascents are always impulsional only. The "two-impulse ascending trajectory" with an immediate impulse and another impulse at the apogee of the final orbit, is generally the optimal solution. We use the usual notations (Chapter 1,2 and figure 1), subscripts 1 are referring to the fictitious launching orbit starting at the practical limit of the atmosphere (about 50 km altitude) subscripts 2 are referring to the target orbit. Author

N68-36354# Library of Congress, Washington, D. C. Aerospace Technology Div.

GAMMA-RADIATION OF THE MOON AND COMPOSITION OF THE LUNAR ROCKS FROM MEASUREMENTS BY LUNA-10

Ivan Velinov *In its* Foreign Sci. Bull. Sep. 1968 refs p 31–38

(See N68-35352 23-23)

A description is given of the instrumentation carried on board the Luna-10 automatic station, and data are presented on the intensity of the gamma radiation emitted from the lunar surface. Author

N68-36390# Aerospace Corp., El Segundo, Calif. Technology Operations.

VELOCITY REQUIREMENTS FOR A SOFT LANDING ON PHOBOS OR DEIMOS IN 1969

J. M. Baker Jul. 1968 38 p refs

(Contract F04701-68-C-0200)

(TOR-0200(4452)-1; AD-673478)

The velocity requirements to soft land on either Phobos or Deimos, the small Martian moons, are determined for the 1969 launch opportunity. A single impulse retro and plane change maneuver is applied at periapsis of the hyperbolic trajectory to achieve the desired final orbit about Mars. Less Delta-V is required to attain the orbit of Phobos. This fact, combined with the lower orbital altitude, makes Phobos the preferred target for a soft landing. The minimum Delta-V for a soft landing does not coincide with the minimum injection energy for a ballistic trajectory to Mars, so that a trajectory can be found that maximizes the payload landed on Phobos. Author (TAB)

N68-36403*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

THE PLANET JUPITER

S. I. Rasool [1968] 21 p

(NASA-TM-X-61288) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Various findings on the planet Jupiter are reviewed, including that Jupiter may have a source of heat in the interior almost four times more than the sun could provide. Jupiter's atmosphere appears to be deficient in hydrogen with respect to helium; and the atmosphere appears to be composed of hydrogen, methane, and ammonia, gases from which the first living organisms are believed to have been synthesized on earth. The meaning of the excess thermal energy and the hydrogen deficiency in the atmosphere are considered in detail; and attention is given to radio wave sporadic emission by Jupiter at frequencies of about 20 mc/s as well as to steady and sustained emission at wavelengths between 3 and 100 cm. Mention is made of the orange and blue coloration of the cloud bands of Jupiter and the presence of the giant red spot; and speculations about this color being related to pre-biological activity are reviewed. M.W.R.

N68-36443# Pan American World Airways, Inc., Patrick AFB, Fla. Aerospace Services Div.

AN ADVANCED INTEGRATION SCHEME FOR ORBITAL TRAJECTORIES

G. D. Trimble AF Eastern Test Range Mar. 1968 25 p
(Contract AF 08(606(-7500)
(AFETR-TR-68-8; AD-673885)

This report describes and illustrates a variation of the Encke scheme for numerically solving the orbital equations of motion which yields an improved accuracy to cost ratio for relatively complex gravity models. The modified Encke approach to solving orbital differential equations of motion and its 12 - 25% savings potential appears quite desirable with the Gauss-Jackson method for orbit determination problems particularly where large derivative routines are prevalent as it is so simple to incorporate. Author (TAB)

N68-36459*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SIMPLIFIED TECHNIQUE FOR DETERMINING PERICYNTHION ALTITUDE OF LUNAR ORBITS

L. Keith Barker Washington Oct. 1968 15 p refs
(NASA-TN-D-4811) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A study has been made of a simplified technique for determining the pericynthion altitude of transfer orbits from a selenocentric circular orbit at 80 nautical miles (148 160 m) to a lower altitude. The transfer orbits had pericynthion altitudes ranging from 0 to 100,000 feet (30 480 m) and radial injection velocities between ±10 ft/sec (±3 m/sec). The technique consisted of measuring the angle between a reference vehicle in circular orbit and the lunar horizon at two specified times. Pericynthion altitude was then determined graphically from these measurements. The effects of errors in measuring the angles, in determining the sighting times, in the circular reference orbit, and in horizon uncertainties were considered. It appears that the technique would be useful for predicting the pericynthion altitude of the transfer orbits and, if necessary, for providing information for orbit corrections. Author

N68-36467*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ANALYSIS OF APOLLO AS-501 MISSION

John E. Dornbach, comp. Feb. 1968 70 p ref
(NASA-TM-X-58015) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An informational content analysis, by a multidisciplinary team, was made of the Apollo AS-501 mission color photographs, taken at an altitude of approximately 10,000 n. mi. during the high-apogee portion of the third revolution. Because of the scale and resolution limitations, no scientific data analyses were performed in areas of geology, geography, hydrology, or cartography; meteorological and oceanic data were limited. Comparisons of ESSA 3 satellite views of the tropical Atlantic with the Apollo color photographs show that color appears to facilitate the capability to differentiate between deep and shallow convective cloudiness, and that there is a noticeable change in color of the sun glint. Evidences were also presented for the relation of cloud patterns to sea surface circulations and for ocean water color variations. Recommendations for planning future photography missions for the earth resources disciplines are discussed at length. B.P.

N68-36468*# Raytheon Co., Sudbury, Mass. Space and Information Systems Div.

ELECTROMAGNETIC PROBING OF THE MARTIAN IONOSPHERE AND ATMOSPHERE FROM AN ORBITING PAIR Final Report, 19 Jun.–19 Dec. 1967

19 Dec. 1967 217 p refs
(Contract NAS8-21222)
(NASA-CR-98001; R67-4537) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Electromagnetic probing of a planetary ionosphere and atmosphere from an orbiting pair is a method capable of providing unambiguous determination of three dimensional ionospheric and atmospheric density profiles. Refractivity, transmission absorption spectroscopy and radiometric measurements at suitable wavelengths, with the instrumentation accommodated in a dual-spacecraft configuration, provide a convenient experimental approach. Two Voyagers or equivalent spacecraft, orbiting the planet Mars at the same time, offer a suitable platform for conducting a comprehensive survey, encompassing spacecraft to spacecraft and spacecraft to sun occultation measurements, complemented by radiometric probings. Author

N68-36492# Joint Publications Research Service, Washington, D. C.

REPORTS ON 1966 PULKOVO ASTROMETRIC CONFERENCE

26 Sep. 1968 36 p refs Transl. into ENGLISH from Tr. 17-Y Astrometricheskoy Konferentsii SSSR (Moscow), 1967 p 65–70, 195–199, 202–211 Presented at the 17 Astrometric Conf., Pulkovo, 31 May–3 Jun. 1966
(JPRS-46531) CFSTI: HC $3.00/MF $0.65

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1. RE-REDUCTION OF OBSERVATIONS OF FKSZ STARS INTO THE FK4 SYSTEM A. G. Oborneva p 1–8 refs (See N68-36493 23-30)

2. RESULTS OF USE OF SOME FILTERS FOR SOLAR MERIDIAN OBSERVATIONS O. T. Markina and G. M. Petrov p 9–14 (See N68-36494 23-30)

3. METHODS OF FLEXURE DETERMINATION N. V. Nazarova and A. S. Kharin p 15–20 refs (See N68-36495 23-30)

4. MODERN TASKS OF PHOTOGRAPHIC ASTROMETRY A. N. Deych p 21–23 (See N68-36496 23-30)

5. PRELIMINARY DATA ON THE OPTICS OF AN ASTROMETRIC REFLECTOR Yu. S. Streletskiy p 24–28 refs (See N68-36497 23-30)

N68-36493# Joint Publications Research Service, Washington, D. C.

RE-REDUCTION OF OBSERVATIONS OF FKSZ STARS INTO THE FK4 SYSTEM

A. G. Oborneva *In its* Rept. on 1966 Pulkova Astrometric Conf. 26 Sep. 1968 p 1–8 refs (See N68-36492 23-30)

A detailed exposition of the observation conditions and the method for the re-reduction of Moscow catalogues of star declinations FKSZ (Mos_{41} and Mos_{56}) into the FK4 system are described. Observational diameter errors, personal-instrument errors, and equatorial point deviations were analyzed to derive declination correction tables. A comparison of the new declination catalogue with previous catalogues is included. D.A.E.

N68-36494# Joint Publications Research Service, Washington, D. C.
RESULTS OF USE OF SOME FILTERS FOR SOLAR MERIDIAN OBSERVATIONS
O. T. Markina and G. M. Petrov *In its* Rept. on 1966 Pulkova Astrometric Conf. 26 Sep. 1968 p 9–14 (See N68-36492 23-30)

The effect of using various filtering techniques on solar observations with the Freiberg–Kondrat'yev transit are discussed. Defects in the present filter system are detailed, and a slit screen filter system is compared with a plane-parallel glass plate mirror filter, and with a dark glass placed on the eyepiece. The mean square error induced by heavy solar radiation in the transit is mentioned. Solar right ascension observations for each system are compared in a table. D.A.E.

N68-36495# Joint Publications Research Service, Washington, D. C.
METHODS OF FLEXURE DETERMINATION
N. V. Nazarova and A. S. Kharin *In its* Rept. on 1966 Pulkova Astrometric Conf. 26 Sep. 1968 p 15–20 refs (See N68-36492 23-30)

Instability of the line of sight in a telescope due to simple mechanical flexure, and deformations arising in the objective and the micrometer due to gravitational effects and temperature changes are assessed. A method of flexure determination is proposed, based on an optical device placed within the telescope tube and used to determine the flexure of the eyepiece. Also, it is proposed that autocollimation from a mirror set in front of the objective and rigidly attached to the objective mounting be used in determining the overall flexure of the eyepiece and the objective. D.A.E.

N68-36496# Joint Publications Research Services, Washington, D. C.
MODERN TASKS OF PHOTOGRAPHIC ASTROMETRY
A. N. Deych *In its* Rept. on 1966 Pulkova Astrometric Conf. 26 Sep. 1968 p 21–23 (See N68-36492 23-30)

The role of classical astronomical observation and photography is discussed in relation to the newer methods of radio astronomy. Determination of precise coordinates of stars on photographs for comparison with radio emission sources, orbit determination and relative motion of multiple stars, and determining trigonometric parallaxes of faint stars are mentioned. D.A.E.

N68-36497# Joint Publications Research Service, Washington, D. C.
PRELIMINARY DATA ON THE OPTICS OF AN ASTROMETRIC REFLECTOR
Yu. S. Streletskiy *In its* Rept. on 1966 Pulkova Astrometric Conf. 26 Sep. 1968 p 24–28 refs (See N68-36492 23-30)

The optics of a Ritchey-Chretien and a Strand-type reflection system for astronomical observations are discussed. Mirror optics, field of view, focal length, and materials used are considered. Formulas for determining longitudinal astigmatism and coma of a parabolic mirror are presented. D.A.E.

N68-36510*# Ohio State Univ. Research Foundation, Columbus.
INVESTIGATIONS INTO THE UTILIZATION OF PASSIVE SATELLITE OBSERVATIONAL DATA
James P. Veach Jun. 1968 115 p refs
(Grant NGR-36-008-093; OSURF Proj. 2514)
(NASA-CR-97187; Rept.-110) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This report deals with passive satellites recorded against the stellar background on the photographic plate of a metric camera. The trail of a passive satellite consisting of several hundred images on a photographic plate may be utilized for geodetic purposes in several ways: (1) All image coordinates may be fitted to a single polynomial with the time as argument and all the information on the plate is aggregated into a single highly precise fictitious satellite direction; (2) The image coordinates may be divided into 3–4 groups and a separate polynomial is fitted to each group; (3) Each or selected images may be reduced individually and used in the geodetic solution. In this case there will be as many simultaneous observations deduced from each pair of plates as many images were selected; and (4) The right ascension and declination of each image may be used directly in the short-arc mode. The paper deals with the results obtained in the four modes mentioned above. The accuracy aspects of the four solutions are investigated. Author

N68-36514*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME NEW POWER SERIES INVERSIONS OF KEPLER'S EQUATION
E. R. Lancaster and R. H. Estes Dec. 1967 17 p refs
(NASA-TM-X-63341; X-643-67-613) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Recursion formulas are derived for the coefficients of three power series inverses of Kepler's equation: 1. a series in powers of time, 2. a series in powers of eccentricity, 3. a bivariate series in powers of two small parameters. For each series a formula is given for the radius of convergence. Author

N68-36625*# TRW Systems Group, Redondo Beach, Calif. Mathematical Physics Section.
ON THE IDENTIFICATION OF OBSERVABLE ORBIT PARAMETERS, WITH APPLICATION TO LUNAR ORBITER TRACKING
C. G. Pfeiffer [1968] 29 p refs
(Contracts NAS9-4810; NAS2-4553)
(NASA-CR-73265) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A technique is developed for identifying those linear combinations of orbit parameters which can be estimated from a given span of tracking data. It is shown that there are class I observable parameters, which affect the data strongly and must be included in the orbit determination solution, and class II observable parameters, which affect the data weakly and can be ignored. The method is numerically applied to two selected lunar orbiter tracking situations. A theoretical explanation of the results is developed to show that one would expect $2n + 4$ combinations of potential terms to be class I observable if an nth order potential model is postulated. A Fourier analysis technique for efficient orbit determination is suggested. Author

N68-36632*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–52, VOLUME I FOR THE PERIOD MAY 1 TO JUNE 30, 1968. FLIGHT PROJECTS
31 Jul. 1968 55 p refs
(Contract NAS7-100)
(NASA-CR-97215; JPL-SPS-37-52, v. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

During this period, the bulk of the operations with the proof-test model (PTM) spacecraft was completed. Assembly and subsystem testing on the first flight spacecraft progressed, and assembly of the second flight spacecraft began. A second combined subsystem test exercising the television and data storage subsystems and the image processing laboratory was conducted, generally validating these equipments and their compatibility. A revision of the spacecraft/DSIF telecommunications interface control document and the compatibility test plan for this interface were issued. In the mission design and analysis area, the planetary quarantine plan and the mission plan portion of the mission plan

and requirements document were completed. Selection of preferred arrival dates was accomplished. Design of the mission operations software system was completed, and development of the individual programs continued during the period. Author

N68-36642# Defence Research Board, Ottawa (Ontario).
THE CHARACTER OF METEORITE BREAK-UP
P. B. Babadzhanov and Ye. N. Kramer May 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSR (Moscow), v. 177, no. 5, 1967 p 1043–1046
(UDC-523.503)

Instantaneous photographs of meteor observations at Dushanbe and Odessa were interpreted. Mechanisms are presented for evaporation, luminescence, and fragmentation. Values of the Perseid meteor's velocity, deceleration, mass, coefficient of ablation, and theoretical deceleration are listed in tabular form for various heights. The increasing coefficient of ablation is seen as evidence of a progressive break-up of the meteorite. Boundary conditions were established for a thermal conductivity equation to determine the time for luminescence to begin. Knudsen's number was calculated to show that at break-up the meteorite was moving in a region of free molecular flow. The liberation of internal energy (evaporation of volatile inclusions) was considered to be another cause of fragmentation. This latter mechanism was evaluated from photographs taken at Odessa. B.P.

N68-36661*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 5 MISSION REPORT. PART 3: TELEVISION DATA
Thomas H. Bird, M. I. Smokler, and D. L. Smyth 15 Jul. 1968 245 p
(Contract NAS7-100)
(NASA-CR-97213; JPL-TR-32-1246) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A selection of 164 television pictures was taken from the more than 19,000 frames transmitted to earth from the lunar surface by Surveyor V between September 11 and December 17, 1967. Copies of 39 selected mosaics are also presented, some of which represent preliminary data constructed during the actual mission operational time. Details are included for the TV system, which included a survey camera capable of panoramic viewing and a TV auxiliary that commutated identification signals and provided appropriate video mixing. Both camera description and camera calibration are detailed, orientation of camera and sun is discussed, and the Surveyor TV ground recording system is described. Camera identifications that accompany each picture were derived from telemetry transmitted with the picture; and these data were validated by using the mission sequence logs, command data logs, and mosaic references. Greenwich Mean Time, azimuth, elevation, focus, iris, lens focal length, filter position, and picture perspective are included in each instance. M.W.R.

N68-36665# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A REVIEW OF SOME QUALITATIVE RESULTS OBTAINED IN FLIGHT DYNAMICS BY THE OPTIMAL PROCESS THEORY [OBZOR NEKOTORYKH KACHESTVENNYKH REZULTATOV, POLUCHENNYKH V DINAMIKE POLETA S POMOSHCHYU TEORII OPTIMALNYKH PROTSESSOV]
V. K. Isaev and Yu. M. Kopnin 28 Nov. 1967 44 p refs Transl. into ENGLISH from Russian
(FTD-HT-23-533-67; AD-673818)

Some features of optimal programming of the thrust magnitude and thrust direction structure during the motion of the variable mass point in a central gravitational field are studied. The presented results contain development and generalization of the authors investigations, reported at the XIVth (1963) and XVth (1964) International Astronautical Congress of IAF. The paper consists of three parts. In the first part the results of the analysis of an optimal disturbed Keplerian two-dimensional motion in the vicinity of the cicular orbit are given on a basis of the p-trajectories theory. The influence of upper atmosphere aerodynamic forces on an optimal correcting program is considered in the second part of this report. In the third part a three-dimensional problem of a satellite elliptic orbit plane turn by a specified angle with a minimal reference velocity is considered. An optimal structure of the modulus and sign control of the jet-force, normal to the orbit plane, is investigated. Author (TAB)

N68-36667* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1971 ORBITER STUDY REPORT
1 Feb. 1968 123 p refs
(Contract NAS7-100)
(NASA-CR-97216; JPL-610-3) CFSTI: $3.00 CSCL 22A

The feasibility of a Mars orbiter mission was assessed, based on a Mariner Mars 1969 design, and the fullest exploitation of existing hardware and technology. Scientific rationale and objectives are developed for the visual imaging, surface temperature investigation, and radio occultation experiments from which the mission objectives for the Mariner 1971 are deduced. The mission profile, including encounter phase and orbiting phase photographic sequences, is delineated, and data return and surface coverage capabilities are discussed. Systems analyses considerations, upon which the gross spacecraft design and flight path selection were based, cover (1) the payload capability of the launch vehicle, (2) the velocity requirement necessary for the spacecraft propulsion system design, and (3) selection of interplanetary trajectories, and of a suitable satellite orbit about Mars. Functional characteristics are defined for telecommunication performance, guidance accuracy-orbit insertion analysis, power margins, and science instrument capabilities. Ground rules for developing an acceptable configuration are stated. Trajectory and performance characteristics are compared for alternative orbiter missions to Mars and Venus. M.G.J.

N68-36785*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
TRAJECTORY ANALYSIS AND GUIDANCE THEORY Second Compilation of Papers, 1 Oct. 1966–1 Oct. 1967
Jan. 1968 350 p refs
(NASA-TM-X-60900; PM-67-21) CFSTI: HC $3.00/MF $0.65 CSCL 22C

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1. AN ANALYSIS OF GUIDANCE MODES C. G. Pfeiffer (TRW Systems) p 7–26 refs (See N68-36786 23-30)

2. OPTIMAL GUIDANCE FROM HYPERBOLIC TO CIRCULAR ORBITS T. N. Edelbaum (Anal. Mech. Assoc., Inc.) p 27–49 refs (See N68-36787 23-30)

3. RESTRICTED MINIMA OF FUNCTIONS OF CONTROLS J. Warga (Northeastern Univ.) p 51–76 refs (See N68-36788 23-19)

4. THE REDUCTION OF CERTAIN CONTROL PROBLEMS TO AN ORDINARY DIFFERENTIAL TYPE J. Warga (Northeastern Univ.) p 77–84 (See N68-36789 23-19)

5. A PRIMER ON THE PRIMER P. M. Lion (Princeton Univ.) p 85–103 refs (See N68-36790 23-30)

6. GROUP THEORETICAL ASPECTS OF THE PERTURBATION OF KEPLERIAN MOTION D. C. Lewis (JHU) and P. Mendelson (Brooklyn Polytech. Inst.) p 105–128 refs (See N68-36791 23-30)

7. COMMENTS ON THE SUNDMAN INEQUALITY D. C. Lewis (JHU) p 129–139 (See N68-36792 23-30)

8. APPROXIMATE DECOUPLING IN THE n-BODY PROBLEM D. C. Lewis (JHU) p 143–171 (See N68-36793 23-30)

9. PERTURBATION OF SOLUTIONS OF DIFFERENTIAL EQUATIONS SATISFYING GENERAL BOUNDARY CONDITIONS D. C. Lewis (JHU) p 173–192 (See N68-36794 23-19)

10. HIGH ORDER TIME DERIVATIVES OF POWERS OF THE RADIUS VECTOR P. Sconzo and D. Valenzuela (IBM) p 193–211 (See N68-36795 23-19)

11. ON THE LONG-PERIOD BEHAVIOUR OF CLOSE LUNAR ORBITERS J. Vagners (Washington Univ.) p 213–228 refs (See N68-38796 23-30)

12. THE EFFECT OF THREE-DIMENSIONAL, NON-LINEAR RESONANCES ON THE MOTION OF A PARTICLE NEAR THE EARTH-MOON EQUILATERAL LIBRATION POINTS H. B. Schechter (Stanford Univ.) p 229–334 refs (See N68-36797 23-30)

N68-36786*# TRW Systems, Redondo Beach, Calif. Mathematical Physics Section.

AN ANALYSIS OF GUIDANCE MODES

C. G. Pfeiffer *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 7–26 refs (See N68-36785 23-30)

(Contract NAS12-593)

The guidance modes are surveyed with the objective of appraising their usefullness when applied to a unified guidance concept. Unified guidance refers to the application of one hardware system as well as one overall computational scheme for guidance in all phases of a mission. Definitions are given of terms such as guidance, guidance mode, unified guidance, and others. The relationship of guidance to navigation is discussed. A rather comprehensive survey of presently known guidance modes (USA-developed) is given, and the modes are categorized according to various principles of division. For the evaluation of guidance modes in general, as well as with respect to the applicability to unified guidance, measures of performance are suggested. These concern such criteria as optimality, accuracy, applicability, flexibility, and others. Author

N68-36787*# Analytical Mechanics Associates, Inc., Cambridge, Mass.

OPTIMAL GUIDANCE FROM HYPERBOLIC TO CIRCULAR ORBITS

T. N. Edelbaum *In NASA*. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 27–49 refs Presented at the Colloq. on Advanced Probl. and Methods for Space Flight Optimization, Liege, 19–23 Jun. 1967 (See N68-36785 23-30)

An approximate analytic solution is developed for minimum fuel guidance from an arbitrary point on a hyperbolic orbit into a specified circular orbit. The hyperbola must lie close to the plane of the circular orbit and its periapsis radius must be close to the radius of the circular orbit. Optimization of the midcourse impulse, the finite-thrust terminal burn, and of both maneuvers in combination is considered. The particular problem treated is intended as a simple example of a new, unified guidance technique. Author

N68-36790*# Princeton Univ., N. J.

A PRIMER ON THE PRIMER

P. M. Lion *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 85–103 refs (See N68-36785 23-30)

The necessary conditions for an impulsive trajectory to be optimum can be stated in terms of Lawden's primer vector. Recently, the primer vector has also been shown to have significance for non-optimal trajectories, indicating how these trajectories can be improved. This discussion presents a simplified derivation of both results from a single viewpoint. In addition, a computational scheme for determining optimum n-impulse trajectories is suggested. Author

N68-36791*# Control Research Associates, Baltimore, Md.

GROUP THEORETICAL ASPECTS OF THE PERTURBATION OF KEPLERIAN MOTION

Daniel C. Lewis (Johns Hopkins Univ.) and Pinchas Mendelson (Brooklyn Polytech. Inst.) *In* NASA Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 85–103 refs (See N68-36785 23-30)

(Contract NAS12-93)

The following principle is exploited to obtain five linearly independent solutions of the variational equations for Keplerian motion. The principle: If a system of differential equations is invariant under a continuous and differentiable group of transformations, it is possible in general, by differentiations only, to write down a number of linearly independent solutions of the variational equations equal to the number of independent parameters of the group. In the Keplerian case there is a removable singularity occurring when the motion is circular. A sixth solution of the variational equations is given by differentiation with respect to the eccentricity. Numerous formulas and identities are written out explicitly for manipulations in the elliptic case. A variation of the Lagrange method for integrating nonhomogeneous linear differential equations, especially adapted for systems of second order, is developed and applied to the elliptic case of Keplerian motion. Finally it is shown how the Keplerian differential equations are invariant under a group of transformation which, in general, change the eccentricity provided that one allows the independent variable to undergo a differential transformation. Author

N68-36792*# Control Research Associates, Baltimore, Md.

COMMENTS ON THE SUNDMAN INEQUALITY

Daniel C. Lewis (Johns Hopkins Univ.) *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 129–139 (See N68-36785 23-30)

(Contract NAS12-93)

A new proof is presented of the Sundman inequality with refinements, and its utility in the introduction of a monotonically increasing angular variable for the Lagrangian inertial radius in the n-body problem is presented. The possible amount of information derivable, from these considerations by studying them in the light of the integrable two body problem is discussed. Author

N68-36793*# Control Research Associates, Baltimore, Md.

APPROXIMATE DECOUPLING IN THE N-BODY PROBLEM

Daniel C. Lewis, Jr. (Johns Hopkins Univ.) *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 143–171 (See N68-36785 23-30)

(Contract NAS12-93)

Formalization of approximate decoupling in terms of the limiting values of certain parameters contained in the equations is discussed. Details are presented in the approximate decoupling of an n-body problem into a k-body problem ($k < n$) and an $(n-k+1)$-body problem in the situation where k of the bodies are relatively close to each other compared to the other mutual distances and where also the k bodies have small masses compared to the other $(n-k)$ bodies. The Hill equations are used for the motion of the moon as a special case of partial decoupling. Theory of so-called quasi-first integrals is discussed which appear in the partially decoupled system and which are derived from first integrals of the unreduced system. A method is given for appraising the validity of an approximate decoupling (either partial or complete) based on the use of Lipschitz constants. There is a problem in the estimation of the Lipschitz constant in terms of bounds for partial derivatives. This problem is solved for the appropriate functions occurring in the n-body problem by proving that in this special case the non-convexity of the region may be ignored. Author

N68-36796*# Washington Univ., Seattle.
ON THE LONG-PERIOD BEHAVIOUR OF CLOSE LUNAR ORBITERS
J. Vagners *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 213–228 refs (See N68-36785 23-30)
(Grant NsG-133-61)
Semi-analytical results are presented for the long term behavior of close lunar orbiters. The moon's aspherical gravity field is described by spherical harmonics through $J_{4,4}$ and the earth is idealized as moving in a circle in the lunar equatorial plane. After the short and medium period terms have been removed from the Hamiltonian, the long period motion is analyzed from equi-energy trajectories in the eccentricity-argument of peri-center plane. Stationary, or resonant, solutions to the slowly varying equations of motion are determined numerically and the results presented as variations of (critical) inclination and eccentricity with semi-major axis. These computations are based on two sets of preliminary values of the lunar harmonics $J_{n,m}$ recently published by sources in the United States and the Soviet Union. Representative equi-energy contours are presented to illustrate the evolution of the long term motion as influenced by orbital inclination, semi-major axis and the parameters $J_{n,m}$. Many stable orbits, in the sense of not impacting the moon, are found even for high inclinations. Author

N68-36797*# Stanford Univ., Calif. Aeronautics and Astronautics Dept.
THE EFFECT OF THREE-DIMENSIONAL, NON-LINEAR RESONANCES ON THE MOTION OF A PARTICLE NEAR THE EARTH-MOON EQUILATERAL LIBRATION POINTS
Hans B. Schechter *In* NASA. Electron. Res. Center Trajectory Analysis and Guidance Theory Jan. 1968 p 229–334 refs (See N68-36785 23-30)
(Grant NsG-133-61)
The results are presented of an analytic study of the 3-dimensional stability of motion of a particle near libration point L_4 in a nonlinear earth–moon force field, upon which is superimposed a linear solar gravitatiional field distribution. In particular, the long period features of the particle's motion are studied, which stem from the excitation at or close to the particle's natural frequencies, and are introduced by the presence of resonance terms in the internal (earth and moon) and external (solar) force fields. The results show that in the presence of the internal nonlinearities the stability of motion predicted by the linear theory is valid for only a very restricted region of initial displacement and velocity distrubances. Disturbances outside this region would lead to divergence of the solution. The nonlinear coupling of the out-of-plane terms with the in-plane terms was found to be of minor importance and did not contribute to an appreciable transfer of energy from one mode of motion to the other. Author

N68-36874# Royal Aircraft Establishment, Farnborough (England).
THE ORBIT OF COSMOS 44 THROUGH THE FIRST CYCLE OF ARGUMENT OF PERIGEE
Eileen Quinn Jan. 1968 19 p refs
(RAE-TR-68023) CFSTI: HC $3.00/MF $0.65
The orbit of Cosmos 44 has been determined from visual and radar observations at intervals during its first complete cycle of argument of perigee, i.e. over a period of nearly 3 years. A table of orbital parameters is given for 13 nodes during this period. The orbital elements are compared with those given in Spacetrack bulletins. ESRO

N68-36907# Boeing Scientific Research Labs., Seattle, Wash.
INFRARED EMISSION FROM THE SURFACE OF THE MOON
Donald F. Winter Apr. 1968 84 p refs
(D1-82-0717; AD-672074)
Contents: Recent infrared observations; heat transfer in evacuated powders; theoretical analysis of surface temperature variations; the effect of surface roughness on apparent temperature; thermal anomalies on the lunar surface. TAB

N68-36914# European Southern Observatory, Hamburg (West Germany).
EUROPEAN SOUTHERN OBSERVATORY BULLETIN NO. 4
Jul. 1968 46 p refs
CFSTI: HC $3.00/MF $0.65
The program of the Danjon Astrolabe at Santiago, Chile, which is being carried out by the Universidad de Chile and the ESO observatory at La Silla (Chile) is reviewed. The current photometric work at La Silla, meteorological observations and services, and the domes for the telescopes are described. ESRO

N68-36952*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Final Report, 17 Sep. 1966–1 Mar. 1968
F. F. Marmo Jul. 1968 124 p refs
(Contract NASw-1283)
(NASA-CR-97185; GCA-TR-68-7-N) CFSTI: HC $3.00/MF $0.65
CSCL 03B
Photochemistry of planetary atmospheric constituents, theoretical studies relating to atmospheric phenomena, laboratory investigations in the VUV and EUV spectral regions, and planetary aeronomy studies are reported. Papers giving the major scientific findings in each of these areas are listed, and the major findings in each of the investigative areas are summarized. Photochemistry studies deal with minor constituents in the atmospheres of Earth, Mars, and Venus; gases in solar EUV radiation, laboratory measurements of ion-molecule reactions and mechanisms in planetary ionospheres; mass and ion energy determinations of photoionization products due to solar VUV and EUV radiation. Ionospheric temperature variations, electron cooling, photon scattering, and dayglow effect on electron impact excitation were studied. Laboratory studies were concerned with absorption and photoionization cross sections, ejected photoelectrons, and fabrication of experimental devices. Theoretical and experimental aeronomy studies were concerned with satellite UV observations and noctilucent clouds, theoretical model atmospheres of Venus and Mars, VUV day airglow in planetary atmospheres, VUV fluorescence due to electron impact excitation of air, and photon scattering cross sections of planetary atmospheric gases. M.W.R.

N68-36953*# American Science and Engineering, Inc., Cambridge, Mass.
LUNAR SURFACE EXPLORATION BY SATELLITE. AN INTEGRATED EXPERIMENT PACKAGE TO PERFORM MEASUREMENTS OF THE COMPOSITION OF THE LUNAR SURFACE Final Report
J. Carpenter, P. Gorenstein, H. Gursky, B. Harris, J. Jordan et al Jun. 1968 151 p refs
(Contract NAS5-11086)
(NASA-CR-97256; ASE-1919) CFSTI: HC $3.00/MF $0.65
CSCL 22A
Present state of knowledge about the moon, results from Surveyor and Luna 10 missions, and the relationship of manned missions to other areas of selenological research are reviewed in terms of lunar surface exploration by spacecraft. Details are presented on the radiation environment at the lunar surface, the physical phenomena and their significance, and the measurement and interrelationships among the various kinds of radiations in the lunar environment. Fluxes, background, experimental techniques, instrumentation, and expected performance are given for gamma ray,

X-ray fluorescence, alpha particle, and neutron albedo experiments. Mention is made of the Pioneer, and anchored IMP, and Lunar Orbiter as possible spacecraft for accomplishing these experiments; and electrical system, mounting and orienting characteristics, and other aspects of the spacecraft are discussed. Attention is given to flight requirements, spacecraft attitude, and orbital parameters.
M.W.R.

N68-36988# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
RESULTS OBTAINED BY MEANS OF WIDE ANGLE CAMERAS [RESULTATS OBTENUS A L'AIDE DES CAMERAS NOCTURNES]
G. Courtes and M. Viton Apr. 1968 21 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

Several photographs made with two wide angle cameras with near ultraviolet transparent properties are analyzed. They show the Orion constellation and the milky way during the winter season.
ESRO

N68-36991# European Space Operations Centre, Darmstadt (West Germany).
BASIC OUTLINE OF NUMERICAL ORBIT INTEGRATION FOR A SYNCHRONOUS SATELLITE
H. A. Kellner and G. Lecerf Paris ESRO Mar. 1968 16 p refs
(ESRO-SM-73(ESOC)) CFSTI: HC $3.00/MF $0.65

The basic physical and programming principles of the present operational integration programs are outlined. A complete collection of formulae for dealing with the relevant perturbations has been compiled. However, operational experience with respect to the actual results of digital orbit simulation is not discussed here.
Author (ESRO)

N68-36992# European Space Data Centre, Darmstadt (West Germany).
THE OBSCURATION OF THE SUN'S DISK DURING ECLIPSE AS SEEN FROM A SOUNDING ROCKET
H. A. Kellner Paris ESRO Aug. 1967 13 p refs
(ESRO-SM-68(ESDAC)) CFSTI: HC $3.00/MF $0.65

Assuming the rocket's trajectory given in topocentric Cartesian coordinates, the necessary formulae are compiled to calculate the fractional obscuration via the Besselian elements of the eclipse which are accessible in the Astronomical Ephemeris Yearbooks.
Author (ESRO)

N68-37057# London Univ. Observatory (England).
TABLE OF SPECTRUM LINE NUMBERS FOR STELLAR PHOTOSPHERIC CONDITIONS
C. W. Allen Jun. 1968 14 p refs *Its* Commun. No. 73
CFSTI: HC $3.00/MF $0.65

Tables of spectrum line numbers are given from computer output. The total density of lines is set out as a function of ν and J over a wide range of temperature and electron density conditions.
ESRO

N68-37059# European Space Vehicle Launcher Development Organization, Paris (France).
A PROGRAM FOR ORBIT DETERMINATION ASSOCIATED WITH LAUNCHING AND STATIONKEEPING OF 24 HOUR SATELLITES
R. Cosaert and E. Gottzein Jan. 1968 85 p refs
(ELDO-TM-110) CFSTI: HC $3.00/MF $0.65

An orbit determination method is described which is tailored for estimating the transfer orbit and orbits encountered during positioning and station keeping of a geostationary satellite from observation of azimuth and elevation (or the equivalent) of a single autotrack antenna. The ultimate version is intended for use in F 11, P.A.S. 1 and subsequent ELDO launchings.
ESRO

N68-37113# Royal Aircraft Establishment, Farnborough (England).
STAR TABLES FOR SATELLITE ATTITUDE CONTROL
P. Haskell Feb. 1968 68 p refs
(RAE-TR-68048) CFSTI: HC $3.00/MF $0.65

The orientation of a satellite within a celestial reference system using star tracking techniques presents a problem of star selection which depends, amongst other things, on the detection capability of the star sensor and how this is affected by the magnitude, spectral class and relative position of other stars within the sensor field of view. These tables have been compiled to assist in the search for suitable stars, by tabulating all stars brighter than +2.5 visual magnitude, together with all stars brighter than +6.25 visual magnitude which lie within 5 degrees of each of the reference stars. Since visual magnitudes are applicable only for detectors having a spectral response the same as that of the eye, colour indices based on black body radiation have been calculated for six photodetector responses for each reference star. These have been tabulated with the spectral class and effective temperature allocated to that class. Curves obtained from the computed colour indices of each of the photodetector responses are included, so that any star may be converted to a detector magnitude for a given detector, if the visual magnitude, spectral class and effective temperature is known.
Author (ESRO)

N68-37166*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
PULSATIONAL INSTABILITIES IN HYDROGEN-POOR MASSIVE BLUE STARS. 1
Norman R. Simon and Richard Stothers [1968] 33 p refs
(NASA-TM-X-61297) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The structure and pulsational properties of massive stars with helium cores and thin, hydrogen-poor envelopes were investigated. The core structures are very insensitive to modifications of the hydrogen envelope. However, it is found that the total stellar radius and luminosity are modified by the integrated hydrogen content and by the hydrogen gradient, respectively. The models are pulsationally stable under modest conditions of central condensation (hydrogen-burning shell and/or high hydrogen content). The unstable models are energized almost entirely by the helium reactions in the core, while most of the damping occurs in the thin, non-burning hydrogen envelope. For each mass, the period (≈hour) is remarkably insensitive to the envelope modifications. The critical models dividing stable from unstable models are determined by (1) a pulsational eigenfrequency $\omega^2 \approx 3$ and (2) the value of the hydrogen gradient.
Author

N68-37202*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
NEAR INFRARED REFLECTIVITY OF VENUS AND ICE CLOUDS
James E. Hansen and Howard Cheyney [1968] 23 p refs
(NASA-TM-X-61295) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The near infrared reflectivity of ice clouds is computed and compared to observations of Venus. The difficulty in making an exact correction for CO_2 absorption precludes the possibility of either establishing or absolutely ruling out ice particles as the primary cloud constituent; however, it is possible to conclude that the clouds are not optically thick and composed of large ice crystals. There is still disagreement as to the quantitative significance of the infrared spectra, but, if it is assumed that a 20% depression may exist in the continuum near 2.0μ, then optically thin clouds ($\tau \leq 5$–10) of ice particles with radii $\leq 4\mu$ are compatible with the observations. It is shown that there is a small amount of positive evidence for such clouds.
Author

N68-37220*# National Aeronautics and Space Administration, Washington, D. C.

NASA SPACE VEHICLE DESIGN CRITERIA (ENVIRONMENT). MODELS OF MARS ATMOSPHERE (1967)

May 1968 24 p refs

(NASA-SP-8010) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Three models of Martian atmosphere having minimum, mean, and maximum density profiles, respectively, were generated by NASA computer programs using temperature and molecular mass distributions, surface pressure, composition, radius of the planet, and acceleration of gravity at the planetary surface as computer inputs. Equations are included for the calculation of density, pressure, speed of sound, density scale height, number density, mean free path, and viscosity. Tables give these parameters for the minimum model for geometric altitudes from 0 to 190 km; for the mean model, 0 to 390 km; and the maximum model 0 to 2500 km. K.W.R.

N68-37273*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MARTIAN SURFACE TEMPERATURES

David Morrison 15 Aug. 1968 41 p refs

(Grant NGR-09-015-023)

(NASA-CR-97272; SAO-SR-284) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The 8- to 13-μ thermal scans made of Mars by Sinton and Strong are the best source available on the distribution of temperature over the disk. These scans were analyzed normalizing to the center-of-disk temperature in the light areas of 290°K. The observed equatorial temperature distribution between sunrise and midafternoon can be reproduced by a solution of the standard heat-conduction equation for a homogeneous subsurface when current values for the planetary albedo and emissivity are employed. The temperature range in the bright areas is from 303 to 180°K with a thermal inertia of 0.004 to 0.005 cal cm^{-2} $sec^{-1/2}$ deg^{-1}; the thermal inertia of the dark areas is slightly larger. Mean particle sizes for the two areas are estimated from the thermal conductivities to be 20 to 40 μ and 100 to 300 μ. The latitudinal temperature gradient is in accord with the model for northern latitudes, but in the south the temperatures are depressed, consistent with the presence of a polar cap of frozen carbon dioxide. At all latitudes, a major fraction of the atmospheric water vapor is expected to condense at night. The radio brightness temperatures observed at centimeter wavelengths are also consistent with these thermal properties. Author

N68-37332# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

OPTIMAL TRANSFERS BETWEEN ELLIPTIC KEPLERIAN ORBITS (TIME-FREE CASE) [TRANSFERTS OPTIMAUX ENTRE ORBITES ELLIPTIQUES (DUREE INDIFFERENTE)]

Christian Marchal 1967 33 p refs In FRENCH; ENGLISH summary

(ONERA-P-120) CFSTI: HC $3.00/MF $0.65

Analytical study of the optimal transfers between elliptic keplerian orbits begins with a short summary of the optimization theory and examines the optimal conditions of rocket utilization. Economy is defined as the minimum expense of propellant for a given transfer. Then, the optimal conditions of rocket utilization are either the use of the maximum exhaust velocity or of a cutoff; these conditions lead to a cost parameter independent of the given rocket: the characteristic velocity, which is the arithmetical sum of all artificial changes of the velocity vector. The following particular cases are studied in detail: transfers between near-circular close orbits, orbits having an eccentricity close to one, equal orbits, and inverse coaxial orbits. Rendezvous, biparabolic transfers, and the replacement of a theoretical impulse by thrusting arcs are also examined. Author

N68-37333# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

DRAG OF A SMALL BODY IN THE WAKE OF A LARGE SATELLITE

Richard A. Oman Oct. 1968 15 p refs

(RM-426)

Calculations of density and momentum flux profiles for free molecular flow at high speed ratio past a two dimensional obstacle have been applied to the estimation of drag on a small body keeping station behind a large satellite. These estimates show that significant savings in fuel can be realized by taking advantage of the relatively large region of reduced free stream dynamic pressure which exists behind the vehicle. This effect might enable a small module, having lower values of M/C_DA, to have the same relative orbital decay as larger satellites or space stations. Author

N68-37340# Martin Co., Denver, Colo.

STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 7: SUPPLEMENTARY REPORT Final Report

Raymond S. Wiltshire, William J. Pragluski, Jos. C. Pohlen, Theodore F. Morey, Dean A. Schneebeck et al Washington NASA Oct. 1968 119 p refs

(Contract NAS1-7976)

(NASA-CR-66700) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The results of the work accomplished in Modification 1 to the Direct Versus Orbital Entry for Mars Missions Study are presented. The objective of this study was to determine and document any changes that the new Mars environmental model, Mars Engineering Model Parameters for Mission and Design Studies, would cause in the results of that study. The mission analysis studies were conducted in two parts. First, all entry trajectories were rerun using the new Mars atmosphere data. The Mach 2 parachute/vernier terminal phase system performance was then analyzed using the initial conditions from the revised entry trajectories. The performance in the new atmospheres in all cases is improved over that in the VM atmospheres, primarily because of the higher density at low altitudes. Author

N68-37347# Lowell Observatory, Flagstaff, Ariz.

LOWELL PROPER MOTIONS 11. PROPER MOTION SURVEY OF THE NORTHERN HEMISPHERE WITH THE 13-INCH PHOTOGRAPHIC TELESCOPE OF THE LOWELL OBSERVATORY

H. L. Giclas, R. Burnham, Jr., and N. G. Thomas 20 Oct. 1967 18 p *Its* Bull. No. 140, Vol. 7, No. 3

A catalog of proper motion stars, covering regions G211 through G225, is presented. Tabulated data on position, motion, magnitude, and color are presented along with the photographic plates. N.E.N.

N68-37364# Copenhagen Observatory (Denmark).

THE DEFINITIVE ORBIT OF THE COMET OLBERS FOR THE PERIODS 1815–1887–1956 WITH A CORRECTION TO THE MASS OF JUPITER

Hans Qvade Rasmusen 1967 104 p refs

(Rept.194) CFSTI: HC $3.00/MF $0.65

An attempt is made to fix the orbit elements for the periodic comet Olbers with such accuracy that the calculated orbit as near as possibly satisfies the observations made during its three apperitions in 1815–1887/88–1955/56. In the investigation is introduced the latest improvement of the planetary masses, but this also includes the adoption of a correction to the mass of Jupiter amounting to –0.3 per cent. The final elements for 1955 can then be used as a basis for the prediction of the comet's next apperition, which is to take place about the year 2026. In the final section

of the paper some remarks about the obtained correction to the mass of Jupiter are given; among these is the conclusion that the computed orbit of comet Halley could only be brought into accordance with the observations from 1759–1835–1910 by introducing a similar correction to the mass of Jupiter. Author

N68-37387# New Mexico Inst. of Mining and Technology, Socorro.
DIGITIZED ASTRONOMY, A DESCRIPTIVE SUMMARY (SAME AS LAST YEAR)
Stirling A. Colgate [1968] 11 p
(Grant NSF GP-6810)

The primary objective of the digitized astronomy project is the early detection of supernovae. The early (4 hours and older) optical history of a supernova gives information concerning the nature of the explosion. The total radiant energy emitted (bolometric luminosity) is proportional both to the surface area of the expanding explosion gases and to the Plank (black body) radianet luminosity. Since this total energy is extremely important to know in order to interpret the observations and theoretical models of our universe, the digitized astronomy project hopes to measure a fair number (1 to 10) supernovae during their earliest optical behavior. Author

N68-37391# Lowell Observatory, Flagstaff, Ariz.
LOWELL PROPER MOTIONS 12
H. L. Giclas, R. Burnham, Jr., and N. G. Thomas 16 Jul. 1968 15 p refs *Its* Bull. No. 144, Vol. 7, No. 7

A catalog of 10 regions lists 549 stars fainter than the 8th magnitude with measured motions $\geq 0''.27$/year, and of these 175 are listed as newly discovered stars. Eight stars are considered to be white dwarf suspects. Data, included for regions G226 through G235 inclusive, were obtained as part of an overall program of direct measurement of proper motions from 13-inch photographic telescope plates having an epoch difference of 30 years that has been underway at the Lowell Observatory since 1957. M.W.R.

N68-37395*# Norton Research Corp., Cambridge, Mass.
FEASIBILITY STUDY OF AN ATMOSPHERIC ANALYSIS EXPERIMENT Final Report
F. J. Brock Jul. 1968 52 p
(Contract NAS1-5347)
(NASA-CR-66683) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A number of general classes of gas sampling systems have been reviewed with respect to their applicability and practicability for use on a high speed entry craft to investigate the atmosphere of Mars. It is concluded that a sampler consisting of a bundle of small diameter tubes having a moderate length-to-diameter ratio, which directs an unscattered molecular beam into the analyzer, has the highest probability of obtaining an exact sample of the undisturbed atmosphere and maintaining it unaltered and uncontaminated until delivered to the analyzer. A theoretical model has been developed, to describe in analytical terms, the high velocity, free molecular flow thru the sampler. This relation may be used to interpret the measured mass spectrum of the unscattered beam in terms of the relative abundance and absolute molecular density in the undisturbed atmosphere. Author

N68-37398*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS RESEARCH
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 1-18 refs (See N68-37397 23-11)

Reported is continuing systems analysis research focusing on the development of (1) computation procedures for finding the shadow entry and exit angles for an artificial satellite of the moon; (2) data processing techniques for computing a consistent ephemeris of the major planets in the solar system; (3) a differential correction process for the correction of the lunar orbit which is based on the use of analytic partial devivatives; and (4) a numerical approximation method to find the coefficients of a Hermite series expansion (used in nonlinear estimation) which is based on the Gram-Charlier expansion. S.C.W.

N68-37399*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 19-23 refs (See N68-37397 23-11)

Described is a proposed Venus coordinate system which is based on conventions for defining the north pole and the direction of positive longitude. Included is an assessment of coordinate system geometry; Venus rotation; and coordinate transformations. S.C.W.

N68-37415*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 182-186 refs (See N68-37397 23-11)

Studies of (1) scattering in the twilight atmosphere of Venus, and (2) water vapor variations on Venus, are reported. S.C.W.

N68-37416*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 187-201 refs (See N68-37397 23-11)

Reported are studies of (1) auroral arcs; (2) rates and mechanisms of the gas phase ozonation of ethylene and acetylene; (3) methods for predicting OH radical microwave lambda doubling transitions below 120 GHz; (4) the escape of helium from the earth's atmosphere using ion cyclotron resonance techniques; and (5) the shape of the magnetosphere. S.C.W.

N68-37421*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FUTURE PROJECTS
In its Space Programs Sum. No. 37-51, Vol. 3 30 Jun. 1968 p 335-341 refs (See N68-37397 23-11)

An assessment of the possible scientific utility of automated lunar roving vehicles for lunar exploration missions is reported. Discussed are design constraints imposed by size, weight, and power since the roving vehicle system will probably fit into a particular launch vehicle; and contraints imposed by specified programs or operating modes. Specific objectives of the imaging system on the rover are discussed as well as scientific tasks or separate missions that an automated roving vehicle can be useful for in a program of lunar exploration. Among the tasks cited are included those related to sample acquisiton; in situ snalysis; transverse geophysics; and special tasks such as instrument deployment; deep seismic probing, exploring the lunar crust for strategic materials, site certification, and seismic missions. It is concluded that the automated lunar roving vehicle presents a versatile technique with wide scientific utility for a program of lunar exploration. S.C.W.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-36056*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ENTRIES FROM EARTH ORBIT THAT SIMULATE ACCELERATION STRESSES OF MANNED PLANETARY MISSIONS

Frederick G. Edwards Washington Oct. 1968 35 p refs

(NASA-TN-D-4847) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The ability to duplicate the acceleration stress during a portion of the earth return of a planetary mission vehicle by appropriate control of an earth orbital vehicle is investigated. The results show that during the entry of an orbital spacecraft it is possible to approximately match the accleration profile corresponding to the initial dive, the capture maneuver, and part of a constant altitude deceleration phase of a planetary mission return entry. A two-step approach to the solution is examined: the analytical step results in a closed form approximate solution for the lift control. An analog computer simulation of the entries uses results from the analytical step and gives a more precise solution for the control. It also permits an evaluation of the cost to the earth entry vehicle in terms of the aerodynamic heating, range capability, and retro velocity requirements. Emphasis is placed on simulating the planetary mission entry at twice orbital velocity, but the results also apply to entry at other supercircular velocities. An Apollo type lifting entry vehicle was used for the examples presented. Author

N68-36106*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPLORATORY STUDY OF PARALLEL STAGE SEPARATION OF REUSABLE LAUNCH VEHICLES

John P. Decker and Joseph Gera Washington Oct. 1968 62 p refs

(NASA-TN-D-4765) CFSTI: HC $3.00/MF $0.65 CSCL 22D

An exploratory study was made of the separation of parallel staged reusable launch vehicles. Static longitudinal aerodynamic data were obtained for a representative two stage rocket powered reusable launch vehicle concept when the stages were in close proximity to each other. The effects of vertical spacing, longitudinal spacing, and incidence angle were determined at Mach numbers 3 and 6. To identify the problems associated with mutual stage interference during the separation maneuver, the equations of longitudinal motion were numerically integrated. The calculation was carried out for a limited number of initial conditions by using a portion of the wind tunnel data along with estimated values of the dynamic derivatives. The experimental results indicated large interference increments on the static stability and normal force characteristics of both vehicle stages. The static aerodynamic data were found to be dependent on the position and attitude of the second stage, the Mach number, and the relative sizes of the two stages. The relative sizes are dependent on the launch mode, the mission requirements, and the choice of propulsion system for the launch vehicle. The trajectory results indicated a strong dependence of the dynamic derivatives, initial attitude, and dynamic pressure on the separation maneuver. Author

N68-36324*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER 4 AND 5 DISTURBANCE TORQUES AND LIMIT CYCLES

Daniel A. Prelewicz 1 Oct. 1968 95 p refs

(Contract NAS7-100)

(NASA-CR-97151; JPL-TR-32-1305) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The disturbance torques acting upon the Mariner IV and Mariner V spacecraft during cruise mode operation are described. The history of the spacecraft rotational motion was obtained by processing sun sensor and Canopus sensor telemetry data, which were used in conjunction with the spacecraft dynamics to obtain qualitative and quantitative disturbance torque characteristics. Interval analysis was used to account for quantization error introduced by the telemetry system. This procedure, together with the assumption of parabolic limit cycles, established definite upper and lower bounds on the disturbance torques at any time. Data for both Mariner IV (Mars 1964) and Mariner V (Venus 1967) indicate that low disturbance torques are present for both spacecraft. Mariner IV has a comparatively large (between 10 and 30 dyn-cm), slowly varying bias torque (apparently a solar torque) as well as a smaller component which changes by as much as 3–5 dyn-cm when a control valve fires. Mariner V is symmetrical about the sun line and hence does not have a large bias solar torque. Since there are no solar vanes, the solar restoring torque is also considerably smaller. However, the disturbance torque, which varies randomly with valve firing (by as much as 2–3 dyn-cm), is present. Author

N68-36373 California Univ., Los Angeles.

ECONOMICS OF RELIABILITY IMPROVEMENT FOR SPACE LAUNCH VEHICLES

Herbert Hecht (Ph.D. Thesis) 1967 203 p

Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-217

A good practical approximation for the marginal failure reduction can be obtained from the failure/value ratio which can be computed from information available during the planning phase of a reliability improvement program. Specific models for the relation between resource expenditure and failure reduction are developed for reliability improvement by redundancy and by test selection. In both cases, it is demonstrated that the failure/value ratio is indeed a workable approximation for the marginal failure reduction. It is concluded that the failure/value ratio can be used for identification of elements to be included in an economically motivated reliability improvement program for space launch vehicles. A simple procedure for allocating improvement resources on the basis of failure/value ratio is developed and applied to an example. The most suitable type of improvement effort for each element can be determined from qualitative factors among which the most significant are knowledge of the failure modes, the extent of the desired improvement, and attitude toward risk. A chart is presented to permit methodical application of these preference factors. Dissert. Abstr.

N68-36526# Aerospace Corp., El Segundo, Calif. Technical Operations.

SPACE ESCAPE SYSTEMS–A STATUS REPORT Technical Report, Sep. 1965–Jan. 1968

Tom Shiokari and David J. South Apr. 1968 36 p refs

(Contract F04695-67-C-0158)

(TR-0158(3520-82)-1; SAMSO-TR-68-290; AD-673350)

Orbital space flight emergencies were studied to identify the more promising approaches for an emergency return capability. Based upon an initial investigation of orbital based, ground based, reentry escape, and space shelter systems, reentry escape systems were selected for further study. Then, a detailed analysis of potential orbital emergencies and their influence upon the characteristics desired in escape systems was conducted. This effort identified structural damage and fire as the most probable types of hazards. By containing these hazards and providing for a safe haven in the spacecraft, accessibility and reaction times of minutes to hours can be provided for escape. For reentry and recovery operations, an analysis was briefly conducted on the coordination of landing sites and reentry procedures. The ground support network appears adequate if planned modifications to the Air Force satellite control facility and emergency communication provisions are incorporated. The technology areas required for escape device development are determination of crew capability, subsystem definition, and spacecraft/escape device integration. Author (TAB)

N68-36546# RAND Corp., Santa Monica, Calif.
ON THE PROBABILITY OF A HIGH-ALTITUDE SATELLITE SEEING A LOW-ALTITUDE SATELLITE
D. N. Morris and L. N. Rowell Jul. 1968 59 p refs
(Contract F44620-67-C-0045)
(RM-4866-PR; AD-673469)

Geometric relations have been developed to express the orientation between the sun, a single high-altitude satellite, and a number of satellites at a lower altitude. It was assumed that the satellites at lower altitude were sufficiently numerous and that their orbital characteristics were sufficiently random so that their locations at a given instant in time could be considered on a statistical basis. With these assumptions, the instantaneous probability that the upper satellite will see a randomly located lower satellite under specified lighting conditions is presented in a series of graphs. Five general cases are considered, each requiring line-of-sight visibility between the upper and lower satellites, but under progressively more restrictive lighting conditions. The general results are then applied to several illustrative examples by placing the observation satellite at synchronous altitude and considering the satellites (or other objects) that were actually in orbit at lower altitudes as of 15 January 1967. Author (TAB)

N68-36580*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER 5 HANDBOOK
1 May 1968 209 p
(Contract NAS7-100)
(NASA-CR-97200; JPL-TM-33-381) CFSTI: HC $3.00/MF $0.65
CSCL 22B

A convenient reference of significant technical data relative to Mariner V mission is presented. The handbook is a compilation of a wide variety of factual information that is scattered throughout a large number of documents on the mission which began on June 14, 1967. The data presented is primarily concerned with operating characteristics and performance of the spacecraft and its various subsystems. B.S.D.

N68-36613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUNA-13—THE LATEST ACHIEVEMENT OF SOVIET SCIENCE [LUNA-3—NOVVY USPEKH SOVETSKOI NAUKI]
14 Sep. 1967 16 p Transl. into ENGLISH from Izv. (Moscow), 31 Dec. 1966 p 1 and 4
(FTD-HT-67-312; AD-673389)

The article describes the Luna 13 soft lunar landing on 24 Dec 66, and compares the differences between Luna 13 and Luna 9. Luna 13 carried a hammerhead soil density meter, a transducer to record the momentum of dynamic acceleration, and a radiation density gauge to determine the density of the lunar surface. It carried radio reception equipment, programed timing mechanisms, chemical batteries, automatic instrumentation, scientific and telemetry apparatus, and a system to control internal temperature. Morphological differences were compared between the Luna 9 and Luna 13 landing sites. Luna 13 was equipped to record only charged corpuscles in the cosmic radiation, which Luna 9 recorded previously. Author (TAB)

N68-36622*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DESIGN AND ECONOMIC ASPECTS OF REUSABLE LAUNCH VEHICLES AND CONSIDERATIONS FOR FUTURE SYSTEMS
H. S. Becker 21 May 1968 48 p refs
(NASA-TM-X-53739) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Recovery and reuse of total vehicle systems has been investigated, as well as reuse of portions of a particular system. The engineering feasibility of being able to fabricate launch vehicles embodying reusable system concepts, and employing either lifting or ballistic return to Earth, has been generally accepted. Considerable uncertainty, however, exists in estimates of the number of flights, or uses, which might be available for new systems of this nature. In other words, what is the market potential for this initially more expensive type of system? This economic aspect, as well as design and specific cost features, are the subject of this paper. Additional thoughts are presented related to whether or not, in our past and current evaluations, we employ comparison methods that properly relate to systems design characteristics. Questions are raised regarding the possibility of our having improperly employed techniques evolved from our ballistic missile background to aircraft type reusable or simplified crude expendable systems, and whether these systems could conceivably employ a different and simplified program approach to development and operations as a result of their basic engineering design features and/or flight modes. Author

N68-36939# European Space Data Centre, Darmstadt (West Germany).
THE MOTION OF A SATELLITE ABOUT AN AXIALLY SYMMETRIC PLANET FORMULATED IN LOCAL INVARIANTS
H. A. Kellner Paris ESRO Dec. 1967 19 p refs
(ESRO-SN-75(ESDAC)) CFSTI: HC$3.00/MF$0.65

Introducing an appropriate set $\mathcal{B}$ of basic local invariants and their integral domain L, the satellite's equation of motion is transformed into a regular set of differential equations, the right-hand sides of which belong to L. The origin, however, remains a singular point. A theorem of Lagrange is generalized. The formulation found is suitable for deriving numerically evaluable recurrence relations for time series expansions. Author (ESRO)

N68-36971*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROMAGNETIC COMPATIBILITY VERIFICATION FOR THE CENTAUR AND SURVEYOR SPACE VEHICLES
John P. Quitter and J. Robert Reiss Washington Oct. 1968 42 p refs
(NASA-TM-X-1673) CSCL 22B

A series of five instrumented electromagnetic compatibility tests were performed on interface circuits between the Surveyor spacecraft and Atlas-Centaur launch vehicle. These tests were performed to verify that the spacecraft would not be susceptible to conductively induced effects from the launch vehicle and complex electromagnetic environment. Initial tests employed spacecraft and launch vehicle simulators in conjunction with their complementary vehicle. The final test was performed on completely assembled flight configuration equipment. Test results indicated the spacecraft, launch vehicle, and launch complex were compatible and that conducted interference levels were below specified limits. Numerical data are presented. Author

N68-36973# Institute of Meteorology, Stockholm (Sweden).
A SUMMARY REVIEW OF METEOROLOGICAL SATELLITES
B. Bolin and D. D. Clark (ESLAB) Paris ESRO Mar. 1968 25 p
(ESRO-SN-85(ESLAB)) CFSTI: HC $3.00/MF $0.65

The value of meteorological satellites in improving the accuracy of weather forecasting and in increasing our understanding of the global circulation of the atmosphere is outlined. Techniques for measuring the various parameters that must be studied are summarized and the current U.S.A. and U.S.S.R. meteorological satellite programs are briefly reviewed. Finally, tentative proposals are made for a European development program in this field, aimed at a first satellite launching in 1973. Author (ESRO)

N68-37004# European Space Technology Center, Noordwijk (Netherlands).
A STUDY OF THE THERMAL BEHAVIOR OF THE ESRO SATELLITE. PART 2: VERIFICATION OF THE MATHEMATICAL MODEL
M. Toussaint, J. Doenecke, and J. Martinet (Limoges Univ.) Paris ESRO Mar. 1968 69 p refs
(ESRO-TN-21(ESTEC)) CFSTI: HC $3.00/MF $0.65

A description is made of a thermal vacuum test to verify a 93-node mathematical model of the ESRO I satellite carried out in the SOPEMEA simulation chamber at Brétigny (France) in January 1967. It is explained how the comparison between measured and predicted temperatures enabled better values for the properties of some of the components of the mathematical model to be deduced, leading to more accurate orbital temperature predictions.
Author (ESRO)

N68-37056# European Space Vehicle Launcher Development Organization, Paris (France).
AIR NAVIGATION SATELLITES, BIBLIOGRAPHY No. 8 [SATELLITES DE NAVIGATION AERIENNE, BIBLIOGRAPHIE No. 8]
M. Gilli and E. J. Lindsay Sep. 1968 9 p refs Partly in ENGLISH and FRENCH
(ELDO-BIB-8) CFSTI: HC $3.00/MF $0.65

This bibliography consists of references covering the period 1963 to June 1968 arranged in date order. It supplements a bibliography made by EUROCONTROL on the same subject which is appended.
Author (ESRO)

N68-37074*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC AERODYNAMIC CHARACTERISTICS OF POWERED MODELS OF SEVERAL APOLLO LAUNCH-ESCAPE VEHICLE CONFIGURATIONS
Bobby Lee Berrier and Odis C. Pendergraft, Jr. Washington Oct. 1968 43 p refs
(NASA-TN-D-4843) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An investigation of several models of Apollo launch escape vehicle configurations was made at Mach numbers from 0.70 to 1.30. The effects of command module strakes, a flow separation device, escape rocket tower modifications, nozzle cant angle, and offset thrust vector were investigated. The escape rocket exhaust was simulated with a hydrogen peroxide rocket mounted upstream of the command module. The angle of attack range was $-5°$ to $31°$, and the average Reynolds number based on the maximum command module diameter was 4.34×10^6 at a Mach number of 0.90. The results of the investigation indicate that axial force (drag) was decreased because of favorable jet interference by adding strakes to the command module, by using a ring attachment type of escape rocket tower, or by increasing nozzle cant angle.
Author

N68-37107# Leicester Univ. (England).
FEASIBILITY STUDY OF A SATELLITE TO INVESTIGATE THE STRUCTURE OF THE SOLAR ATMOSPHERE
K. A. Pounds, R. Pacault (ESTEC), D. Marsh (ESTEC), R. Somoza (ESTEC), and H. Marin (ESTEC) Paris ESRO Aug. 1967 33 p
(ESRO-SP-25) CFSTI: HC $3.00/MF $0.65

This feasibility study deals with an orbiting observatory capable of conveying information about the fine structure of the solar atmosphere (convective layer, photosphere, chromosphere, transition region and corona). The main instrument would be an assembly consisting of a reflecting telescope and a concave grating spectrometer to investigate the emission features in the waveband below 2000Å. A low, circular, maximum-sunlight orbit appears to be the best choice. Preliminary consideration is given to the main spacecraft subsystems, emphasizing the important problem areas.
Author (ESRO)

N68-37117# Stanford Univ., Calif. School of Engineering.
DEMETER: AN EARTH RESOURCES SATELLITE SYSTEM Final Report
Jun. 1968 525 p refs

System design studies are summarized for the Demeter satellite system which will observe the earth in the optical, near infrared, and thermal infrared wavelengths and produce real time multiband pictures approximately every two weeks for distribution to the various users. The objective of the Demeter study is to use space technology to provide a complete, accurate, timely, inexpensive, and relevant inventory of the earth's resources. This study confronts the major development problems of an earth resources satellite system from an economic, political, and technical point of view. Technical design studies are discussed in relation to the scanning sensors, the communication system, the data reduction and distribution system, and satellite configuration. An estimate of costs involved in the development and implementation of the system is also examined. The political and legal problems associated with an earth resource observation system are delineated, and modifications and limitations of the system to reduce the national security problem are suggested.
B.S.D.

N68-37135# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
PROGRAM FOR THE EXPERIMENT CEPHEE [PROGRAMME DE L'EXPERIENCE CEPHEE]
G. Courtes May 1968 35 p In FRENCH
CFSTI: HC $3.00/MF $0.65

CNES and O.N.E.R.A. have jointly developed a rocket nose cone stabilizer called Cassiopée. A test launch will be carried out in the fall of 1968 and will include a scientific experiment called Cephée. It will consist of an ultraviolet spectrophotometer oriented towards the Orion constellation. Telescopes and the electronic equipment used are described as well as the telemetry system. Indications are given on the launching program.
ESRO

N68-37147# United Kingdom Atomic Energy Authority, Culham (England).
DESIGN STUDY OF UNITED KINGDOM SCIENTIFIC PROPOSAL FOR A EUROPEAN LARGE ASTRONOMICAL SATELLITE. SYNOPSIS
R. Wilson Paris ESRO Sep. 1967 139 p refs
(ESRO-SP-5) CFSTI: HC $3.00/MF $0.65

This report is the synopsis of the full design study prepared by Culham Laboratory, in fulfillment of ESRO Contract 3/65 rev. 2. Although some changes have been introduced in the actual design of the Large Astronomical Satellite package since the Culham design study was accepted, this report is issued as a record of the work on which the present LAS design is substantially based.
Author (ESRO)

N68-37245*# Hughes Aircraft Co., Culver City, Calif. Space Systems Div.
IONOSPHERIC ELECTRON CONTENT: SYNCHRONOUS ORBIT BEACON EXPERIMENT DEFINITION Final Report
Jun. 1968 80 p refs
(Contract NAS8-21220)
(NASA-CR-98034; SSD-80225R) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Design concept details are provided on an Inclination Removal Ionospheric Beacon Satellite (IRIBS) that can change or remove inclination after deployment from a manned Apollo Applications Program (AAP) vehicle in an inclined synchronous orbit. Also discussed in the Ionospheric Beacon Satellite (IBS) which can be integrated into a mechanical integration model of the synchronous Apollo spacecraft. For use in a radio beacon experiment to measure the electron content of the exosphere and ionosphere, both satellites are to be deployed into an 28.5° inclined synchronous orbit; the

IBS will operate in this orbit during its useful life. However, the IRIBS can execute at 28.5° plane change, resulting in a stationary synchronous orbit on the equator; this capability is based on retention of the Early Bird satellite apogee motor which can provide this inclination removal. The design modifications required to convert the IBS configuration into the IRIBS are described, along with the mechanical design of the IBS antenna subsystem and electronics requirements. M.G.J.

N68-37248 California Inst. of Tech., Pasadena.
METEOROID SHIELDING AND RADIATION SHIELDING FOR JUPITER PROBES [DIE ERFORSCHUNG DES PLANETEN JUPITER]
W. Kokott 1967 15 p refs Transl. into ENGLISH from GERMAN Rept. BMwF-FB-W-67-40 Presented at the Conf. on the Phys. of the Planet Jupiter and the Space Travel Technol. of a Jupiter Probe, Celle, West Ger., 18–20 Apr. 1967
CFSTI: HC $3.00/MF $0.65

Theoretical and experimental values of meteoroid flux density in the vicinity of the earth are discussed, along with the theoretical distribution of micrometeoroids in the entire solar system. The distribution of asteroid latitudes is depicted and assessed; a figure is included to show that the asteroids cluster somewhat further out under the influence of Jupiter whose sphere of activity at perihelion reaches inside to about 4.5 AU. Abundances are plotted as a function of the absolute magnitudes for three distance zones. It is shown that for the zone of maximal abundance of asteroids (between 2.6 and 3.0 AU) a large irregularity occurs in the magnitude distribution; between 2.0 and 2.6 AU, a minimum exists; for the outer asteroids the curve rises in a rather homogeneous fashion. These data are extrapolated by assuming that the curves may be extended up to the limit which arises through the Poynting–Robertson effect for asteroids that originated one billion years ago. An upper limit for the relative flux density distribution in the asteroid belt is obtained. The suggestion is made that a preliminary mission into the asteroid belt, and a Jupiter fly-by orbiter missions should be planned to assess the amount of shielding needed on a Jupiter probe. M.G.J.

N68-37369*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METEOROLOGICAL DATA CATALOG FOR THE APPLICATIONS TECHNOLOGY SATELLITES, VOLUME 1, 1 JANUARY–30 JUNE 1967
Oct. 1967 469 p Prepared by Allied Res. Assoc., Inc.
(NASA-TM-X-61290) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The ATS-1 Spin Scan Cloud Camera describes the ATS-1 system and offers an explanation of the data acquisition, categorization, cataloging and archiving processes. A computerized data service, based on the categorization scheme is also described. Data documentation is given for the period 1 January 1967 through 30 June 1967. The ATS meteorological data catalogs present the types of data available, a meteorological data log identifying pictures as to time and picture quality, orbital data and a daily example of the photographic data acquired. D.H.B.

N68-37394*# TRW Systems Group, Redondo Beach, Calif.
ORBITING GEOPHYSICAL OBSERVATORY ATTITUDE CONTROL SUBSYSTEM DESIGN SURVEY
K. J. McKenna and H. Schmeichel 28 Jun. 1968 84 p refs
(Contract NAS12-110)
(NASA-CR-86107) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This design survey summarizes the history of the Orbiting Geophysical Observatory's (OGO) Attitude Control Subsystem (ACS) from the proposal phase through current flight experience. Problems encountered in design, fabrication, test, and on orbit are discussed. As a result of flight experience, several ACS changes were made as well as changes in the flight operations philosophy. The false gradient tracking of the horizon scanner system on OGO-2 and the reaction wheel power amplifier failure in OGO-3 necessitated redesign of these units. Subsequent operation on orbit has been flawless. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-36043 Stanford Univ., Calif.
EXPERIMENTAL STUDIES ON THE INSTABILITY OF CIRCULAR CYLINDRICAL SHELLS
Stanley Carl Bailey (Ph.D. Thesis) 1967 275 p
Available from Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 67-17391

A brief discussion and visual representation of the instability modes for a wide range of practical bodies is presented and the correlation between theoretical predictions and experimental behavior is examined. Five experiments to determine the initial buckling load of thin shells, influenced by the test system stiffness, are described, statistically analysed and discussed. Some 315 tests were conducted, 215 on cylinders under axial compression, and 100 on cylinders under external pressure. Ranges in test machine extensional stiffness from 589,000 lb in to 2400 lb in were considered; shell radius to wall thickness ratios ranged from 226 to 1419 and ratios of actual buckling load to classical value varied from 0.249 to 0.77. The results provide evidence that the Tsien criterion is inapplicable in all problems considered. Dissert. Abstr.

N68-36102 North Carolina State Coll., Raleigh.
A PROBABILITY MODEL FOR RANDOM FIBER BREAKAGE
Sung Won Lee (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-17885

Two fundamental questions in connection with the random breakage of fibers in a breakage system are set forth: Given a fiber group of any particular length, (1) What is the probability that a fiber of the length groups breaks at all? (2) What is the probability that a fiber breaks into s segments ($s \geq 2$)? To clarify the questions, a probability model for the uniformly random breakage of fibers of uniform length is derived with multisegment fiber breakages taken into account. Then, the model is extended to the case where the input fiber distribution is a nondegenerate arbitrary distribution. The applicability of the matrix model is demonstrated on two different lots of cotton fibers which had different prefiber process histories in cotton ginning process. It can be concluded that the consideration of a flexible relation between the probability of fiber breakage and length and multisegment fiber breakage in a fiber breakage model is pertinent for realistic interpretation of fiber breakage phenomena. Dissert. Abstr.

N68-36109*# National Aeronautics and Space Administration, Washington, D. C.
ANALYSIS CONTROL AND DESIGN OF A MECHANICAL SYSTEM SUBJECT TO VIBRATIONS [ANALISIS, CONTROL Y DISENO DE UN SISTEMA MECANICO SUJETO A VIBRACIONES]
Miguel Angel Esparza Aranda (Ph.D. Thesis—Univ. Autonoma de San Luis Potosi, Mex.) Oct. 1968 111 p refs
(NASA-TT-F-11910) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The discussion begins with a definition of vibrations, how they originate and their principle causes as well as their classification for study. The vibrations are analyzed according to this classification and the manner in which they should be studied. Attention is given to different methods used in solving the vibration problems according to the precision required and the time and means available. Known methods that are used to control the vibrations when they can not be avoided in the design due to factors of cost and manufacture, are described. The application of isolators to control the vibrations in an internal combustion machine is discussed. The more important instruments used in the measurement of vibrations are described. Conclusions derived from the study are given. Author

N68-36164#
ON BUCKLING MODES OF AN ELASTIC ROD UNDER IMPACT
V. M. Kornev 27 Oct. 1967 6 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), no. 3, 1968 p 63–68
CFSTI: HC$3.00/MF$0.65

A simplified method is given for determining the curved mode of a rod under impact as a system with one degree of freedom. This mode is quite similar to the mode obtained in experiments on a rod under impact compression. An elastic sandwich rod under impact, as well as a homogeneous ring under specific loading conditions, are considered. Author

N68-36186# Harry Diamond Labs., Washington, D. C.
MECHANICAL ENGINEERING OF PLASTIC NOSE CONES HAVING STRESS-CRACKING TENDENCIES
George K. Lucey, Jr. Jun. 1968 46 p refs
(HDL-TR-1396; AD-673700)

Relaxation (applied strain) data are necessary to select a material that can withstand the level of strain in the XM429 design without stress cracking. However, such data are not available for polyphenylene oxide and many other plastics used in ordnance. This prompted a study of the applicability of the more abundant data, namely creep (applied stress), constant strain rate, and bursting pipe (applied pressure) data to this problem; means of using these data in an applied strain problem are described. Bursting pipe data are used to show that low melt index, high-density polyethylene is a material mechanically acceptable for use on the XM429. Author (TAB)

N68-36189# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
SURVEY OF PLASTICS SANDWICH CONSTRUCTION
Nicholas T. Baldanza May 1968 104 p refs
(PLASTEC-34; AD-673713)

A survey of plastics structural sandwich constructions is presented, containing technical information and references that should give the designer and materials engineer a better understanding of the potential usage of these techniques. The information is applicable to the design and fabrication of structural sandwich components for tank-automotive usage or similar applications. Included are technical data and references relating to specifications, various types of sandwich facings and core components, adhesives, sealants, fasteners, ballistics, and nuclear radiation protection. The state-of-the-art search concludes that sufficient advantages of sandwich construction exist to warrant further investigation of practical applications. Author (TAB)

N68-36244# Technische Hogeschool, Delft (Netherlands).
THE TANGENTIAL FORCE TRANSMITTED BY TWO ELASTIC BODIES THAT ROLL OVER EACH OTHER WITH PURE CREEPAGE
J. J. Kalker Apr. 1968 15 p refs
(WTHD-3; Rept.-349) CFSTI: HC$3.00/MF$0.65

An empirical formula is proposed which gives the connection between the two components of creepage and the total tangential force transmitted by two rolling elastic bodies. The formula is tested by means of the experimental results of JOHNSON, the numerical results of KALKER, and by means of the creepage coefficients which were calculated by KALKER according to a method derived by DE PATER. The empirical formula is in good agreement with the evidence. Author

N68-36281# North Carolina State Coll., Raleigh. Applied Mathematics Research Group.
THE DISTRIBUTION OF STRESS IN THE VICINITY OF A PENNY SHAPED CRACK IN AN ELASTIC SOLID UNDER THE ACTION OF SYMMETRIC BODY FORCES
John Tweed 5 Aug. 1968 25 p refs Submitted for publication
(Grant AF-AFOSR-444-66)
(PSR-47/14; AFOSR-68-1835; AD-673850)

The method of an earlier paper is used to derive formulae from which may be found the spread criterion and the distribution of stress in the vicinity of a penny-shaped crack in an elastic solid which is acted upon by an axisymmetric distribution of body forces. The use of these formulae is illustrated by a consideration of the special case in which the solid is deformed by the action of two point forces situated symmetrically with respect to the crack. Author (TAB)

N68-36292# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE NONLINEAR FLUTTER OF A PLATE FIXED ALONG ITS PERIMETER [O NELINEINOM FLATTERE PLASTINY, ZASHCHEMLENNOI PO KONTURU]
B. P. Makarov Aug. 1967 11 p refs Transl. into ENGLISH from the Russian
(FTD-HT-67-217; AD-673653)

An investigation was made of the stability of rectangular plane plates clamped along the edge, with one side in a gas stream of large supersonic velocity. The normal deflection is assumed to be comparable with the thickness but small with regard to the length of the sides. Aerodynamic forces are determined on the basis of an asymptotic formula valid for velocities considerably exceeding the velocity of sound. The initial system of equations of motion is reduced to two ordinary differential equations by Galerkins method. Periodic solutions of these are found by the method of small parameter. The calculations show that for moderate values of mu = Mh/a (M being Machs number, h the thickness, a the length of the plate) the amplitude is of the order of h and the excitation of flutter is soft. Author (TAB)

N68-36298# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
LIQUID PROPELLANT ROCKETS [LES FUSEES A PROPERGOLS LIQUIDES]
Touesnant [1968] 45 p In FRENCH
CFSTI: HC$3.00/MF$0.65

The principles guiding research on liquid propellant rockets are emphasized, and difficulties encountered by their manufacturers summarized. The technological trends are analyzed. ESRO

N68-36299# National Physical Lab., Teddington (England). Aerodynamics Div.
THE PROBABILITY ANALYSIS OF THE OSCILLATIONS OF SOME WIND TUNNEL MODELS REPRESENTING TALL BUILDINGS
L. R. Wootton Dec. 1967 26 p refs
(NPL-AERO-1254) CFSTI: HC$3.00/MF$0.65

Some experimental results of model buildings show that the probability distributions are reasonably normal at amplitudes

below about twice the root mean square value but can differ appreciably at the extreme amplitudes that may be of interest to the structural engineer. Author (ESRO)

N68-36301#
STABILITY OF A CYLINDRICAL SHELL IN THE COUPLE-STRESS STATE
E. M. Koroleva 31 Mar. 1968 9 p refs Transl. into ENGLISH from PMM (Moscow), v. 32, no. 4, 1968 p 696–702
CFSTI: HC $3.00/MF $0.65

The stability of an infinite cylindrical shell subjected to ring loading is investigated. The solution of the problem is given on the basis of linearization of the near-couple-stress state. The numerical analysis is carried out on the Minsk-12 electronic digital computer. The cases of ring loading acting on an infinite shell, of ring loading acting on a semi-infinite shell, and of a system of moments distributed uniformly over the endface are considered. In all cases the critical loading and the number of waves at buckling are determined. Author

N68-36312 Michigan Univ., Ann Arbor.
POST BUCKLING BEHAVIOR OF TEE SHAPED ALUMINUM COLUMNS
Rafi Hariri (Ph.D. Thesis) 1967 226 p
Available from Univ. Microfilms: HC $10.35/Microfilm $3.00
Order No. 67-17771

The post buckling behavior of a tee shaped column of aluminum alloy is the subject under study in this thesis. Attention is focused on the cases where the buckling is initiated in the plane of symmetry. A complete evaluation of tee-section column behavior is needed to provide an accurate estimate of the effects of initial column imperfections, eccentricity of loading, the preferred modes of buckling and to afford a confirmation of the qualitative predictions made in the preceding paragraph. To achieve the foregoing aims an algorithm has been developed for use on a digital computer to provide by an incremental process a complete simulation of tee-section column behavior. Bounds of behavior of a column, specifically a tee column, are discussed and the differing inelastic buckling graphically. The problem of torsion of a cross section subjected to a varying strain in the inelastic range with possible presence of strain regression region is also treated. Dissert. Abstr.

N68-36331*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A NOTE ON THE FIRST PASSAGE TIME PROBLEM
J. N. Yang and M. Shinozuka 15 Oct. 1968 10 p refs
(NAS7-100)
(NASA-CR-97149; JPL-TR-32-1334) CFSTI: HC $3.00/MF $0.65
CSCL 20K

An analytical formulation of the first passage time problem for a linear single-degree-of-freedom vibratory system with a linear viscous damping, and subjected to either stationary or nonstationary white noise excitation, is obtained as a well posed initial-boundary value problem. The fomulation is based on the Kolmogorov backward equation, rather than the Fokker–Planck equation. Author

N68-36350#
ENERGY CRITERION OF THE STABILITY OF ELASTIC BODIES WHICH DOES NOT REQUIRE THE DETERMINATION OF THE INITIAL STRESS-STRAIN STATE
N. A. Alfutov and L. I. Balabukh 4 Mar. 1968 8 p refs Transl. into ENGLISH from PMM (Moscow), v. 32, no. 4, 1968 p 703–707
CFSTI: HC $3.00/MF $0.65

If the initial stress state of a body is described by linearelasticity theory, then an energy criterion for neutral equilibrium can be formulated directly in terms of the external loading and the governing bifurcation of the displacements is shown. To do this, the fundamental first order displacements and additional second order displacements, on which external potential forces perform work during buckling, are introduced to describe the deflected equilibrium position of the body. These additional quadratic displacements are expressed in terms of the first order displacements. Therefore, the stability problem of an elastic body can be solved without first determining its initial stress state. The result obtained can be considered as the foundation and extension of the energy stability criterion. Author

N68-36385 Washington Univ., St. Louis, Mo.
THE ELASTIC-PLASTIC BEHAVIOR OF MULTI-STORY, UNBRACED, PLANAR FRAMES
Alfred Korn (Ph.D. Thesis) 1967 279 p
Available from Univ. Microfilms: HC $12.60/Microfilm $3.00
Order No. 67-17168

An elastic-plastic behavioral study of seventeen fixed base frames is presented. Inelastic effects are simulated by use of the plastic hinge idealization. The frames, either one or two-bays in width and two to fifteen-stories in height, are subject to complete force and deformational analyses at the formation of each plastic hinge up to collapse. Each frame is subject to first and second order analyses with and without the consideration of axial deformation. Curvature shortenings due to bending are also considered for a few selected second order analyses. Parametric studies of several portal frames are also presented. It is shown that catastrophic early frame instability is prevented by suitable controls on frame behavior at working loads. Frames that are free of early instabilities are capable of developing a major portion of their predicted first order collapse load capacity. Dissert. Abstr.

N68-36420 California Univ., Berkeley.
ANALYSIS OF ELASTIC PLASTIC SHELLS OF REVOLUTION UNDER AXISYMMETRIC LOADING USING THE FINITE ELEMENT METHOD
Mahmoud Khojasteh-Bakht (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00
Order No. 68-93

The finite element method using a displacement model is employed to analyze the behavior of elastic-plastic shells of revolution under axisymmetric loading. Both perfectly plastic and work hardening materials are treated. The solution is based on the new curved element which can take specified slopes and curvatures at its modal circles. Various methods of expressing the geometry of a curved element are discussed, and the elements developed are well-conditioned for all ranges of latitude angle. Representation of the displacement pattern in both rectilinear local and curvilinear surface coordinates are compared. The former is found to be superior in accommodating the rigid body translation and the constant straining modes. A general treatment of the elastic-plastic problem in connection with the finite element method is given. The tangent stiffness method and the initial strain method, which treats the plastic deformation as a fictitious load, are compared. The former method was selected for use in the analysis. Numerical examples are given to illustrate the convergence and the accuracy. Dissert. Abstr.

N68-36476# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A REFINED THEORY OF NONHOMOGENEOUS TRANSVERSALLY ISOTROPIC PLATES OF AN ASYMMETRICAL STRUCTURE [UTOCHENNAYA TEORIYA NEODNORODNYKH TRANSVERSALNO-IZOTROPNYKH PLIT NESIMMETRICHNOI STRUKTURY]
S. G. Lekhnitskii 19 Sep. 1967 18 p refs Transl. into ENGLISH from AN SSSR Izv., Mekhan., no. 1, 1965 p 81–88
(FTD-HT-67-58; AD-673693)

An analysis is given of the problem of the elastic equilibrium of two types of nonhomogeneous transversally isotropic thick plates of asymmetrical structure: (1) multilayer plates and (2) plates with moduli of elasticity continuously variable in the thickness. If the load is distributed only along the edge, it is possible to distinguish two main forms of a stressed state: (1) plane stressed state and (2) buckling. For each of the two forms of stressed state solutions are obtained which rigorously satisfy all the equations of the theory of elasticity in each layer, the boundary conditions on the outer planes and on the surfaces of contact of the layers, whereas on the lateral surface (on the edge) the average or integral conditions are satisfied, as in the theory of thin plates. Thus, the plate is regarded as a thick plate in the A. Love or A. I. Lurye sense. By knowing the solution for a plane stressed state and for buckling it becomes possible to obtain a solution for more complex cases of loading, especially for the case of normal forces distributed uniformly over the entire area of one of the plane surfaces. Author (TAB)

N68-36511*# Massachusetts Inst. of Tech., Cambridge. Acoustics and Vibration Lab.

THE MEASUREMENT OF MECHANICAL POWER FLOW INTO A SIMPLE PANEL

Larry E. Wittig 19 Oct. 1967 13 p refs

(Contract NAS8-2504)

(NASA-CR-98002; DSR-78867-1) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The purpose of this investigation was to see how well we could measure mechanical power flow into a vibrating structure. To do this we excited a simple panel through a mechanical impedance head. The acceleration signal of the impedance head was integrated to give the average power flow into the panel. The power dissipated in the panel, which is a function of the mean square acceleration and loss factor of the panel, was determined and compared to the measured power input. The agreement between the curves that we obtained show that power can be measured with a reasonable degree of accuracy. Author

N68-36523# North Carolina State Univ., Raleigh. Applied Mathematics Research Group.

THE DISTRIBUTION OF STRESS IN THE VICINITY OF A GRIFFITH CRACK IN AN ELASTIC SOLID IN WHICH BODY FORCES ARE ACTING

J. Tweed 18 Jul. 1968 54 p refs

(Grant AF-AFOSR-444-66)

(AFOSR-68-1760; AD-673884)

In a recent paper by Sneddon and Tweed a simple method was given of determining the stress intensity factor and crack shape of a Griffith crack in an elastic body in which body forces are acting. In the present paper the author wished to show that the same method may also be used to find the spread criterion and to determine the distribution of stress in the vicinity of the crack. Author (TAB)

N68-36524# Brown Univ., Providence, R. I. Div. of Engineering.

LOCAL HEATING BY PLASTIC DEFORMATION AT A CRACK TIP

Nouri Levy (M.S. Thesis) and James R. Rice Apr. 1968 33 p refs

(Contract N00014-67-A-0191)

(TR-1; AD-673300)

This paper presents calculations of the temperature elevations accompanying rapid plastic deformation near a crack tip. Solutions for the stress and strain distribution in non-hardening materials are employed as a basis for the heating rate distribution. Results are approximate in that temperature independent mechanical and thermal properties are assumed and thermal stressing is neglected. Two cases are considered: a stationary crack under increasing load, and a running crack with locally constant speed and plastic zone size. Numerical results are presented as based on properties of 2024 aluminum alloy, 6A1-4V titanium alloy, and mild steel. Temperature rises predicted for test conditions on these metals seldom exceed 100C. This may, nevertheless, be large enough to influence fracture and to account for the observed rise in roughness at very fast rates. Consequences are examined for the assumption that the localized tip temperature elevation alone governs fracture toughness at very fast rates. Author (TAB)

N68-36592*# Kansas Univ., Lawrence. Engineering Science Div.

AN INVESTIGATION OF THE PARAMETRIC RESONANCE OF RECTANGULAR PLATES REINFORCED WITH CLOSELY SPACED STIFFENERS

Roger C. Duffield and Nicholas Willems Aug. 1968 69 p refs

(Grant NGL-17-002-001)

(NASA-CR-97191; Rept.-31) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This investigation determines theoretically the boundaries of the regions of parametric resonance of a simply supported stiffened rectangular plate with closely spaced stiffeners of uniform size subjected to periodic in-plane boundary forces. A theory is developed for plates reinforced by either or both longitudinal and transverse stiffeners. The effects of torsional rigidity and rotary inertia of the stiffeners are also taken into account. The effects of size and location of the stiffeners on the boundaries of the regions of parametric resonance are studied. Author

N68-36594# Sandia Corp., Albuquerque, N. Mex.

PHASE VELOCITIES OF ELASTIC WAVES IN STRUCTURAL COMPUTER PROGRAMS

R. D. Krieg Nov. 1967 41 p refs

(Contract AT(29-1)-789)

(SC-DR-67-816) CFSTI: HC $3.00/MF $0.65

Dynamic structural computer programs can generally be described by the matrix equation: $M|\ddot{q}| + K|q| = |f(t)|$ where M and K are mass and stiffness matrices, respectively, and $|q|$ and $|f(t)|$ are column matrices of generalized displacements and forcing functions. The behavior of the simplecentral differenced time solution of this equation is investigated analytically. The investigation goes a step beyond a stability analysis since the behavior of the solution for all stable time steps is investigated. In particular, the velocity amplitude of an initial velocity problem will be too high for short wavelengths if the time step size is near critical, and the frequencies of the ordinary set of differential equations above are always lower than from the finite differenced (in time) equations. The results are specialized to a straight elastic beam where phase velocity is investigated. Bending wave velocities are shown to be limited in contrast to the solutions of the analogous partial differential equations. Author (NSA)

N68-36620# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYMMETRICAL LOADING OF AN INFINITE PLATE WEAKENED BY THREE CIRCULAR HOLES [SIMMETRICHNOE NAGRUZHENIE BESKONECHNOI PLASTINKI, OSLABLENNOI TREMYA KRUGOVYM OTVERSTIYAMI]

M. Z. Narodetskii 19 Sep. 1967 14 p refs Transl. into ENGLISH from Akad. Nauk Gruzin. SSR. Soobshch. (USSR), v. 20, no. 2, 1965 p 295-302

(FTD-HT-67-78; AD-673894)

A solution is given of the problem of the elastic equilibrium of an infinite plate with three identical circular holes (arranged in line and equally spaced) which is subjected to uniform pressure applied to the edges of the holes. Complex representation of stress functions is used in solving the problem. A method developed by N. I. Muskhelishvili is applied in setting up functional equations

for the complex-variable stress functions. By introducing auxiliary functions describing the stress-strain relations in the hole-weakened domain, a general expression with unknown coefficients which represents the solution of the problem is written. After performing certain transformations and using the boundary conditions for the middle hole and side holes, expressions for determining the unknown coefficients are obtained. The solution obtained in this way can be easily extended to other types of symmetrical plate loading. Calculation procedures in cases when a uniform pressure is applied only to the edges of the side holes (the edge of the middle hole is free of external loads), and vice versa, are indicated. The values of coefficients calculated by means of three approximations are given in a table. It is noted that the third approximation does not introduce any essential corrections and thus can be omitted even under the most unfavorable conditions (when the edges of neighboring holes are close to each other). A diagram showing the stress distribution is given. Author (TAB)

N68-36687 California Univ., Berkeley.
A REFINED FINITE ELEMENT ANALYSIS OF THIN SHELL STRUCTURES INCLUDING DYNAMIC LOADINGS
Athol James Carr (Ph.D. Thesis) 1967 240 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-41

An investigation is described of the application of a refined triangular finite element to the analysis of thin shell structures, of arbitrary form, for the effects of static and dynamic loading. To develop an element suitable for a shell analysis, in the sense that it possesses all three translational and rotational degrees of freedom at each nodal point, a refined plane stress finite element with a quadratic variation of strain is combined with a fully compatible plate bending finite element. The resulting shell finite element has a cubic displacement pattern and is capable of undergoing the general transformation of axes required in the direct stiffness method of structural analysis. The concept is extended to obtain the dynamic properties of a general shell structure. Finally techniques are developed to obtain the response of a shell roof structure to an arbitrary ground acceleration history, such as that produced by a strong earthquake. Digital computer programs to use the refined shell element are discussed and examples of their application are presented. Dissert. Abstr.

N68-36758# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE Quarterly Progress Report, Oct.–Dec. 1967
R. J. Eiber, W. A. Maxey, A. R. Duffy, and T. J. Atterbury 1 Jan. 1968 18 p
(Contract W-7405-ENG-92)
(BMI-1828) CFSTI: HC $3.00/MF $0.65

Nine full-scale experiments were conducted on 24-in.-OD by 1.50-in. nominal wall thickness A1068 pipe. Six of these experiments employed through-wall notches-five under subcooled conditions, one under a wet vapor condition. The range of temperatures was 554 to 675°F. The other three experiments involved surface flaws-one under a subcooled condition, the other two under wet vapor conditions. The through-wall flaw formulation requires additional experimental verification to permit accurate prediction of the failure stresses of through-wall flaws at relatively high stress levels in the vicinity of the yield stress. The through-wall flaw formulation presently provides a reasonably accurate estimate of the failure stress in this region. The surface flaw experiments indicate that the predicted failure stresses are within ±5 percent of the experimental values. Additional work is needed to verify these results. Three types of fracture extension have been observed—complete rupture, short crack extension, and a leak. For material of a given toughness the first two are believed at this time to be dependent upon the geometry of the defect and the state of the pressuring medium. The third type is believed to be dependent only on the geometry of the defect for material of a given toughness. Author (NSA)

N68-36816# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
INVESTIGATION OF CRATER GROWTH AND EJECTA CLOUD RESULTING FROM HYPERVELOCITY IMPACT OF ALUMINUM SPHERES ON THICK ALUMINUM TARGETS
Russell H. Smith (M.S. Thesis) AF Matel. Lab. Jun. 1968 31 p refs
(GSF/MF/68-10; AFML-TR-68-175; AD-673515)

An experimental investigation was conducted of crater growth and ejecta cloud formation from the impact of 3.2 mm aluminum spheres on thick aluminum targets at 7 km/sec. Crater growth and transient shape were determined through sequential flash X-rays. Growth followed a decaying exponential pattern, and the tangent angle to the crater wall at the target surface remained virtually constant. Relationships between ejecta-cloud parameters and crater diameters were investigated. Cloud-edge motion was determined and an effort made to determine particle origin. Velocities of discrete particles in the cloud were determined. Author (TAB)

N68-36819# Sandia Corp., Albuquerque, N. Mex.
SOLUTIONS TO PROBLEMS OF BENDING SYMMETRICALLY AND ASYMMETRICALLY LOADED CIRCULAR CYLINDRICAL SHELLS WITH SIMPLY SUPPORTED EDGES
Roy L. Johnson, Jr. Dec. 1967 31 p refs
(Contract AT(29-1)-789)
(SC-DR-67-883) CFSTI: HC $3.00/MF $0.65

The solutions to several problems in bending of circular cylindrical shells with simply supported edges due to discontinuous symmetric and asymmetric radial loadings are presented. The method of solution employs a double trigonometric Fourier series to represent the unknown displacements and given loads. The result is a set of algebraic equations for the Fourier series coefficients of the displacements in terms of the loads. These have been solved for several loadings and the results presented. Author (NSA)

N68-36833# Argonne National Lab., Ill.
FORMULAS FOR CIRCULAR PLATES SUBJECTED TO SYMMETRICAL LOADS AND TEMPERATURES
James C. Heap Dec. 1967 312 p refs
(TID-23984) CFSTI: HC $3.00/MF $0.65

A collection of formulas for circular plates subjected to symmetrical loads and temperatures is given. Loadings considered include unequal, uniform moments along edges; uniform loads on concentric circles; variable power-term load on concentric annulus; uniform load on concentric annulus; trapezoidal load on concentric annulus; concentrated load at center of plate; force intensity per radius on concentric annulus; constant force per radius squared; and superpositioned cases. Thermal stresses and displacements of circular plates having symmetrical temperature distributions are also included. NSA

N68-36887*# Philco-Ford Corp., Newport Beach, Calif. Space and Reentry Systems Div.
STRUCTURAL STABILITY ANALYSIS OF THE APOLLO SHORT STACK
Gerald P. Cohen and Charles G. Dietz 27 Sep. 1968 81 p refs
(Contract NAS9-8424)
(NASA-CR-92331; UG4489) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The buckling strength of the Apollo short stack, consisting of the S4-B forward skirt, instrument unit, and spacecraft LM

adapter, under axial compression was studied by means of digital computer codes based on Novozhilov shell and ring theory. Essentially three types of buckling modes were detected: (1) inextensional modes extending throughout the structure, (2) S4-B skirt modes, and (3) higher modes involving significant SLA action, particularly at the LM ring. The minimum critical loads obtained for these types of modes are respectively: 1.13×10^6 lbs., 1.34×10^6 lbs., and 1.49×10^6 lbs. If the effects of a 0.1 inch imperfection and the discrete LM ring loads are included, the first buckling load given is unaffected whereas the second and third are reduced to 1.10×10^6 lbs. and 1.03×10^6 lbs., respectively. Author

N68-36932*# Melpar, Inc., Huntsville, Ala. Analytical Dynamics Lab.

STABILITY OF A SIMPLY SUPPORTED ROD SUBJECTED TO A RANDOM LONGITUDINAL FORCE

R. R. Mitchell and F. Kozin (Polytechnic Inst. of Brooklyn) May 1968 83 p refs

(Contract NAS8-21111)

(NASA-CR-98016) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The stability of a simply supported rod which is subjected to a random longitudinal force is studied. The concepts and interrelationships of moment stability and sample stability are defined. These definitions are then applied to the rod deflection, stability problem and sufficient conditions for second moment stability are determined for three types of random longitudinal force: Gaussian white noise, a narrow band noise, and a Gaussian noise with a general power spectral density function satisfying certain conditions. It is then shown that the conditions derived for second moment stability actually yield sample stability. A discussion of sample stability and second moment stability for a first order system and some interesting results concerning the stabilization of an inverted pendulum by subjecting its base to a random vertical displacement are also presented. Author

N68-36945# Technische Hogeschool, Delft (Netherlands). Lab. of Engineering Mechanics.

PURPOSE AND ACHIEVEMENTS OF RESEARCH IN ELASTIC STABILITY

W. T. Koiter Jun. 1968 23 p refs Presented at the 4th Tech. Conf. of the Soc. for Eng. Sci. of N. C. State Univ., Raleigh, N. C., Nov. 1966

(WTHD-8; Rept.-363) CFSTI: HC $3.00/MF $0.65

Current criticisms of the theory of elastic stability are reviewed, and the present situation of this theory is appraised for elastic structures under (static) conservative loading conditions. Continued reliance on the energy criterion in its naive conventional form appears to be justified. Legitimate simplifying approximations of the energy functional are also discussed. Attention is drawn to the essential nonlinear aspects of the theory, necessary for a proper understanding of the actual behaviour after buckling and also of the sometimes disastrous effect of geometric imperfections. Author

N68-36958# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

CALCULATION OF ROTORS FOR NEUTRON SPECTROMETRY [CALCULS DES ROTORS DE SPECTROMETRES A NEUTRONS]

Guy Gobert Mar. 1968 58 p refs In FRENCH; ENGLISH summary

(CEA-R-3467) CFSTI: HC $3.00/MF $0.65

The determination of stress in a rotating disc plane of symmetry normal to the axis of rotation has been studied by a number of investigators. In a recent paper Reich gives an operating process for an analytical solution in an asymmetric rotating disc. The calculation of finite difference stress solutions applicable to the two rotating discs is given. The equations are then programmed for the 360.75 computer by Fortran methods concerning the rotors of choppers. Author (ESRO)

N68-36961# Texas Univ., Austin. Engineering Mechanics Research Lab.

AN ELASTIC INSTABILITY ANALYSIS OF ORTHOTROPIC OGIVAL SHELLS OF REVOLUTION SUBJECTED TO STATIC AXISYMMETRIC EXTERNAL PRESSURES Final Report

Thomas Glynn Priddy Oct. 1967 112 p refs Prepared for Sandia Corp.

(Contract AT(29-1)-789)

(SC-CR-67-2709) CFSTI: HC $3.00/MF $0.65

An energy formulation is presented for the elastic stability problem of thin orthotropic shells of revolution subjected to static axisymmetric loading. Parameter variations retained in this formulation permit: eccentricities in shell construction, different effective Poisson's ratios for bending and extensional strains, orthotropic rigidities, and variation of these in the meridional direction of the shells. These construction details are sometimes needed in the analysis of filament wound shells, and applying averaged rigidity assumptions, in the analysis of eccentrically stiffened shells. Approximate solutions are explored for an ogival shell under external pressure loading. A systematic numerical analysis procedure is utilized to accommodate the complicated construction details and to permit various refinements in meridional buckle mode shapes. Two types of assumed edge support, simply supported and fixed, are studied. Routines are included for an analysis of filament wound ogive construction. Author (NSA)

N68-37080*# Tennessee Technological Univ., Cookeville.

STRESS WAVES IN LAMINATED MATERIALS Final Report, 1 Sep. 1967–30 Aug. 1968

Ray Kinslow 30 Aug. 1968 99 p refs

(Grant NGR-43-003-007)

(NASA-CR-97267) CFSTI: $3.00 CSCL 20K

Propagation and reflection of stress waves in solid and laminated targets were studied. This included an analysis of the material properties, target geometry, and stress wave characteristics. Experimental investigation of the stresses developed by the stress waves was limited to sandwich plates of only three layers, the two bounding layers being of one material, and the center layer of a different material. The outer layers were transparent and could be studied by photoelastic methods. After analysis of the experimental results, a theoretical model was formulated. By using the theoretical model, the effects of laminations were calculated. These results were compared with those obtained experimentally for identical targets. Author

N68-37213 Aeronautical Research Inst. of Sweden, Stockholm.

OPTIMUM DESIGN OF JOINTS: THE STRESS SEVERITY FACTOR CONCEPT

Lars Eric Jarfall [1967] 7 p Presented at the 5th ICAF Symp., Melbourne, 22–24 May 1967

A rational method of analysis that emphasizes the fatigue characteristics of the structure rather than its static strength, is described. A central concept in this analysis method is the stress severity factor, which is an analytically defined fatigue quality number. The factor is supposed to express only the fatigue quality as influenced by the structural configuration; not the effect of material quality and stress level. The application of the stress severity factor requires a detailed analysis of the load distribution within the structure, in order to establish the load transfer at every fatigue critical fastener location. Experimental evaluation of fastener fatigue characteristics for the stress severity factor application is discussed, and some results from fastener deflection studies are

presented. Finally a few examples are presented to demonstrate the application of the method as well as the correlation with test data and service experience. Author

N68-37256# State Inst. for Technical Research, Helsinki (Finland).
ON THE STIFFNESS ON NON-MONOLITHIC STRUCTURES
Herman N. Parland (Ph.D. Thesis) 1968 115 p refs
(Publ.-123) CFSTI: HC $3.00/MF $0.65

An attempt to develop a unified method for treatment of non-monolithic structures in the elastic area is represented. The general conditions to which stresses and deformations are subjected in cracks and joints which do not transfer tensile stresses are treated. Generally speaking, elastic behaviour in the cracks of structures is possible only if no slip occurs at the crack surfaces. An exception in this respect is formed by smooth frictionless jointing surfaces, along with initial slipping with so called complete contact in the cracks. The latter case permits the definition of the elastic component of the friction. The solution of the boundary value problem and stiffness characteristics are considered. An analysis of periodic, symmetrical bodies is presented, along with a survey of some applications of the theory to the bending of reinforced and prestressed concrete beams in the cracking stage, and to some buckling problems. Finally an outline is given of the problem of lateral buckling of cracked reinforced beams. Author

N68-37267*# Princeton Univ., N. J.
INFLUENCE OF IN-PLANE SUPPORT FLEXIBILITY ON THE NONLINEAR FLUTTER OF LOADED PLATES
C. S. Ventres and E. H. Dowell [1968] 7 p refs
(Grant NGR-31-001-124)
(NASA-CR-97255) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Theoretical results for the flutter of a two dimensional clamped edge plate exposed to a constant static pressure differential with existing experimental data for a panel with a length-width ratio of 0.46 are compared. The results indicate that relatively massive and seemingly rigid panel support structures can be effectively quite flexible insofar as their restraint at in plane motions of the boundaries of the panel are concerned. They showed further that excellent correlation between theory and experiment can be obtained by assuming a suitable degree of support flexibility. The amount of flexibility present was estimated in an approximate manner. Author

N68-37356 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF A SEMI-AUTOMATIC METHOD FOR THE APPROPRIATION OF THE EXCITATION FORCES IN AIRPLANE GROUND VIBRATION TESTS [CONTRIBUTION A L'ETUDE D'UNE METHODE SEMI-AUTOMATIQUE D'APPROPRIATION DES FORCES D'EXCITATION DANS L'ESSAI AU SOL D'UNE STRUCTURE D'AVION]
Alphonse Deck 1968 83 p refs In FRENCH; ENGLISH Summary
(ONERA-NT-129) CFSTI: $3.00

Following a brief survey of the vibration tests by the global method, the theoretical possibility of separating a vibration natural mode in a complex structure is examined. The practical problem for separating a mode, as well as the critical analysis of the existing appropriation methods are discussed. The theoretical and experimental study of a systematic iteration method of appropriation of the excitation is exposed. This method leads to the determination of the excitation forces separating a mode at its natural frequency, as well as to the determination of this frequency. Finally, the project of a set up which should make operational the process studied is exposed as well as the study of a method for analysing the response of the structure by means of a synchronous sampling of this response. The central component of this set up is constituted by a digital computer of the industrial type. Author

N68-37386*# Volt Technical Corp., Washington, D. C.
VELOCITY FIELD EXCITED BY WING VIBRATIONS PROPAGATING ALONG ITS SURFACE WITH SUPERSONIC VELOCITY
E. A. Krasil'shchikova NASA 18 Oct. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, no. 4, Oct. 1968 p 783–786
(Contract NAS5-12487)
(NASA-CR-97259; ST-AD-10765) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The problem discussed in the present paper results in defining a function which determines the amplitude and the initial phase of oscillations at each oscillating point of the surface of the wing. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-38039*# Utah Univ., Salt Lake City. Chemical Engineering Dept.
AMMONIUM-PERCHLORATE DIFFUSION FLAMES: A SPECTROGRAPHIC INVESTIGATION
W. R. Aiman, N. W. Ryan, and A. D. Baer 1 Jul. 1968 75 p refs
(Grant NGR-45-003-019)
(NASA-CR-97126) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Diffusion flames between a body of ammonium perchlorate (AP) and various fuel sources—solid polybutadiene-acrylic-acid copolymer or gaseous methane or hydrogen—were investigated spectroscopically over a wavelength range of 0.3 to 5.5μ. With gaseous fuels, the flame was approximately in the center of the gap between the fuel source and the surface of the AP. An AP-*vs.* AP flame was produced, but it was totally nonvisible to the eye. The polymer flames were very close to the fuel surface. Spectrograms are published for the hydrogen-*vs.*-AP, methane-*vs.*-AP, AP-*vs.*-AP, and polymer-*vs.*-AP flames in the 1.9-to-4.7μ range. For the methane-*vs.*-AP flame, temperatures of about 2400°K were measured by a sodium-D-line-height-comparison technique as a subsidiary study. CO_2, H_2O, HCl, CH_4, and probably N_2O were detected in the flames. No evidence of CO was found. HCl emission was observed as near the surface of the polymer as it was possible to observe; however, it was not detected near the AP surface. Similar results were obtained in the gaseous-fuel flames. It is concluded that HCl was not a primary product of the gasification of AP. Author

N68-38040*# Arizona Univ., Tucson. Energy, Mass and Momentum Transfer Lab.
INTERNAL LOW REYNOLDS NUMBER TURBULENT HEAT TRANSFER
Harold C. Reynolds, Jr. Jan. 1968 199 p refs Sponsored in part by NASA and NSF
(Contract DA-31-124-ARO(D)-314)
(NASA-CR-97098; EMMT-LAB-TR-2; AROD-5403-4-E; AD-669254) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The results of a semi-analytical and experimental study of adiabatic tube flow and an analytical and experimental

investigation of the thermal entrance region for gas flowing through electrically heated circular tubes are presented. Emphasis is placed on the low Reynolds number turbulent flow regime--defined as fully turbulent flow at bulk Reynolds numbers from 3,000 to about 15,000. Adiabatic air velocity and friction data and localized heat transfer measurements for air and helium, at low heating rates, are presented for this range. Author (TAB)

N68-36054 Virginia Univ., Charlottesville.
THE EFFECT OF HEAT CURRENTS ON THE SCINTILLATION OF LIQUID HELIUM
James Spangler Vinson (Ph.D. Thesis) 1967 52 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17629

Observations are reported of unusual phenomena associated with the heating of small wires in liquid helium and the effect of heat currents on the scintillation of liquid helium. Sharp increases in the intensity of alpha particle induced scintillation of liquid helium are observed at certain critical values of the heat current. The alpha activity was plated on a segment of .009 cm, Ni-chrome wire. The results indicate that the increases in scintillation intensity are related to the formation of a vapor bubble around the wire or the sudden onset of turbulence near the wire. The magnitude of the critical heat current and whether bubble formation or turbulence occurred were found to depend significantly on the level of liquid helium above the wire source. The temperature dependence of the critical heat current at constant source depth was also studied. Dissert. Abstr.

N68-36072*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE REACTION-PLANE APPROXIMATION IN ABLATION ANALYSES
C. W. Stroud Washington Oct. 1968 21 p refs
(NASA-TN-D-4817) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Equations which describe the reactive zone in charring ablators during steady state ablation are derived. Average reaction zone temperatures and reaction zone thicknesses are studied for half-order, and second-order reactions. This study was made for each of these reaction orders over a wide range of frequency factors and heats of pyrolysis. One technique used to simplify ablation analyses is to idealize the degradation process and assume that it occurs in a plane. The purpose of this paper is to investigate the validity of this technique as a good engineering approximation. Empirical relations are developed between the frequency factors and the average reaction zone temperature for the three reaction orders. These relations are used to locate the reaction zone in a reaction plane analysis. The resulting temperature profile is shown to be in substantial agreement with the profile obtained from a reaction in depth analysis. Author

N68-36093 Tulane Univ., New Orleans, La.
AN INVESTIGATION OF THE RELATION BETWEEN FLAME SHAPE AND CHAMBER COMBUSTION EFFICIENCY FOR A FLAME STABILIZED BY AN OPPOSED-JET FLAMEHOLDER
George William Douglas, Jr. (Ph.D. Thesis) 1967 58 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17908

An investigation was undertaken in order to determine the flame spreading characteristics of an opposed-jet stabilized flame and their relation to chamber combustion efficiency. Tests were conducted in a standard combustion tunnel at atmospheric pressure, using premixed propane and air as reactants. The approach velocities in the test section were subsonic, ranging from 65 feet per second to 132 feet per second. A chamber combustion efficiency equation based on the increase in the rate of momentum was used to study the variation of chamber combustion efficiency in the flame spreading region. This efficiency was shown to correlate with the fraction of the duct cross-sectional area occupied by the flame, as well as the fraction of the inlet mass flow rate that was burning. The entrainment characteristics of the opposed-jet stabilized flame were examined downstream from the tip of the opposed-jet tube. Dissert. Abstr.

N68-36104 Michigan Univ., Ann Arbor.
THE PROPAGATION AND STRUCTURE OF TWO PHASE DETONATIONS
Kenneth Waterman Ragland (Ph.D. Thesis) 1967 217 p
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 67-17833

The propagation of a detonation wave in a tube containing gaseous oxygen and liquid fuel in the form of droplets or in the form of a layer on the walls was experimentally investigated. The gas dynamics of the reaction zone was studied with space resolved and streak, self-luminous and schlieren photography, as well as with pressure transducers and platinum heat transfer gauges. A new lead metaniobate pressure transducer with a tin acoustic absorbing rod was designed for this purpose. The surprising observation that a detonation can propagate through a stream of fuel droplets with a diameter as large as 0.26 cm, and also in a tube which has a thin layer of liquid fuel on the walls, demonstrates the ease with which a detonation can propagate in two phase media. Dissert. Abstr.

N68-36113*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF PHASE-CHANGE COATINGS FOR USE AS VARIABLE THERMAL CONTROL SURFACES Final Report, 8 Mar. 1967–8 Mar. 1968
R. N. Griffin and B. Linder 8 Mar. 1968 71 p refs
(Contract NAS1-6166)
(NASA-CR-66695) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The present work was devoted primarily to the development of practical phase-change coatings whose operating temperature is as close as possible to normal room temperature. About a hundred formulations were made and tested in the search for a room temperature phase-change coating. At least two room temperature phase-change coatings were developed which may be satisfactory for short missions, but further work is required for the development of such coatings for prolonged exposure in space. Coatings of dilauryl phosphite in poly(vinyl butyral) undergo a phase-change between about 6°C and 20°C. However, we were unable to find an overcoat which was impermeable to the dilauryl phosphite. As a result, gradual evaporation of the pigment occurred in vacuum. Formulations of amyl stearate in poly(vinyl butyral) performed well in all respects except that irradiation testing produced variable and inconsistent results. Some samples survived irradiation testing with little damage while in others the overcoat became white and opaque. The use of some other overcoat may suffice to make phase-change coatings containing amyl stearate useful near room temperature. Author

N68-36195#
CHAPTER 4. COAXIAL TURBULENT JETS AND FLAMES. "PRINCIPLES OF GAS FLAME THEORY"
L. A. Vulis, Sh. A. Erchin and L. P. Iarin [1968] 16 p refs Transl. into ENGLISH from Energiia Press (Leningrad), 1968 p 79–98
CFSTI: HC $3.00/MF $0.65

Summary data are presented on the aerodynamic testing, without burning, of gas burners in the form of coaxial nozzles. The intensity of turbulent mixing and the factors affecting it are considered in connection with turbulent flame development. The intensity of the change in fuel and oxidizer concentration, as well as the temperature in the mixing zone, are identified as the most

important characteristics of the mixing and combustion process. Comparative data are depicted to show the effect of variations. Experimental results are also presented on the aerodynamic structure of a coaxial diffusion flame. M.G.J.

N68-36219 Stanford Univ., Calif.
A STUDY OF SOME ASPECTS OF THERMAL CONVECTION
Antonio Vidal (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-17523

The effect of uniform rotation on convection driven by surface tension gradients is considered both theoretically and experimentally. The theoretical analysis follows the usual small disturbance approach of perturbation theory and leads to a relationship between the critical Marangoni number and the Taylor number. Even though the linear stability properties of such systems have been well established, no quantitative verification of the predicted stability criteria has been achieved to date, mainly because liquid systems with a free surface do not generally support pre-convective linear temperature profiles as was assumed in previous analyses. An attempt was made to test the hypothesis that in cellular convection, the fluid motion at the center of the cell is in the direction of increasing kinematic viscosity. The equations describing the transport of heat and momentum in a fluid layer heated from below are written in a modified Boussinesq approximation which allows for a temperature dependent viscosity. Dissert. Abstr.

N68-36302# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF THE AVERAGE COEFFICIENT OF HEAT TRANSFER FOR LIQUID METALS BY THE HEAT-EXCHANGER METHOD [IZMERENIE SREDNIKH KOEFFITSIENTOV TEPLOOTDACHI ZHIDKIKH METALLOV METODOM TEPLOOBMENNIKA]
D. I. Gremilov and D. M. Kalachev Sep. 1967 13 p refs Transl. into ENGLISH from Zhidkie Metally. Sb. Statei (Moscow), 1963 p 158–164
(FTD-HT-67-353; AD-673844)

Experimental determination of the coefficient of heat loss by direct measurement of the surface temperature of the heat exchanger is difficult in some cases, especially when working with liquid metal heat carriers with high coefficients. The average coefficient of heat transmission may be much easier to determine in simple heat-exchangers. The article describes a method for finding the average coefficients of heat loss for different rates of monophasic turbulent flow of liquid metal in channels of a given shape on the basis of experimental measurement of the coefficients of heat transmission. Author (TAB)

N68-36336# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF A MAGNETIC FIELD ON THE STAGNATION-POINT FLOW PAST A BLUNT BODY IN THE PRESENCE OF ABLATION OF AN ELECTRICALLY CONDUCTING SHIELD [VLIYANIYE MAGNITNOGO POLYA NA TECHENIYE V OKRESTNOSTI KRITICHESKOY TOCHKI TUPOGO TELA PRI ABLYATSII ELEKTROPROVODNOGO ZASHCHITNOGO SLOYA]
E. A. Tropp 3 Oct. 1967 14 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 3, 1966 p 17–25
(FTD-HT-67-455; AD-673846)

The two- and three-dimensional hypersonic axisymmetrical flows of a mixture of chemically reacting viscous gases and vapors of a subliming material past blunt body are considered under the effect of a homogeneous magnetic field normal to the body surface. It is assumed that the external electric field is absent, the gas behind the shock wave is sufficiently dense, the applied magnetic field is weak, and the electrical conductivity of both the gas and vapors is constant. Thus, the effect of the induced magnetic field is neglected. The boundary layer equations differ from those of gasdynamics by the term which accounts for a ponderomotive force in the equation of motion. A system of nondimensional equations of a steady self-similar flow regime in the stagnation-point region is derived. The analysis includes the equations of the boundary layer in the gas, and in the molten material, and the equations of thermal conductivity in a solid body with boundary conditions on the outer edge of the boundary layer, on the interface of a gas and a molten material, on the interface of a molten material and a solid body, and inside a solid body. Electrically nonconducting and electrically conducting gas flows were considered. Author (TAB)

N68-36342# Bureau of Mines, Amarillo, Tex.
THERMODYNAMIC PROPERTIES OF HELIUM, NITROGEN, AND HELIUM-NITROGEN MIXTURES FROM 240° R TO 950° R FOR PRESSURE BETWEEN 14.696 AND 3,000 PSIA
Robert E. Wood Oct. 1968 371 p refs
(BM-RI-7190)

The Leiden form of the virial equation of state was used in thermodynamic equations to compute specific volume, enthalpy, entropy, internal energy, Joule–Thomson effect, fugacity-pressure ratio, isobaric specific heat, and excess enthalpy and entropy of mixing values for the helium-nitrogen system. Tabular values for these properties for helium, nitrogen, and nine helium-nitrogen mixtures, at 10.00 percent helium increments, are presented for 46 temperatures in the range 240° to 950° R, and for 26 pressures in the range 14.696 to 3,000 psia. The computed thermodynamic properties are compared with experimental C_p and J-T data and properties derived from other equations of state. Author

N68-36344# Michigan Univ., Ann Arbor.
HYPERSONIC BLUNT BODY FLOW OF HYDROGEN OXYGEN MIXTURES
Arnold J. Galloway and Martin Sichel Jul. 1968 145 p refs Prepared for Purdue Univ.
(Contract N00014-67-A-0226; Proj. Squid)
(MICH-8-PU; AD-673543)

The stagnation region of the shock layer in high velocity flow of hydrogen-oxygen mixtures over blunt bodies is investigated. The method of series truncations is used to obtain numerical solutions of the conservation equations, using complete hydro-oxygen kinetics. A local linearization scheme is applied to the integration of the chemical rate equations in order to reduce computation time. First order solutions are obtained with acceptable accuracy in a relatively short computation time. A second order solution is computed in one case to test the convergence and results in negligible modification of the first order solution. In qualitative agreement with experimental observations, it is found that there is a steep combustion front between the shock and the body, and that combustion results in an increase in shock standoff distance as compared to non-reactive flow. The results are consistent with a previously developed scaling law for hydrogen-oxygen flows. Near-frozen flows exhibit a thin region of rapid chemical reaction adjacent to the body. A parameter identifying this regime is developed, and the shock layer flow of an idealized reacting gas is investigated. An equation describing this flow is presented, and preliminary results indicate that the gas model exhibits the important characteristics of near-frozen shock layer flows. Author (TAB)

N68-36394# RAND Corp., Santa Monica, Calif.
EXPLORATORY STUDIES ON THE SUBLIMATION OF SLENDER CAMPHOR AND NAPHTHALENE MODELS IN A SUPERSONIC WIND TUNNEL

A. F. Charwat Jul. 1968 71 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5506-ARPA; AD-673531)

A summary is given of a systematic study of the sintering of powdered camphor and naphthalene after deaeration under vacuum. It is shown that models machined out of stock prepared in this way have a shear strength twice that of cast models, are completely homogeneous, and are well suited to wind-tunnel experiments on the aerodynamics of sublimating bodies. Exploratory tests on cones with flat and hemispherical noses and on several complex conical shapes featuring downstream and upstream facing steps, rectangular grooves, and shoulders are described. Emphasis is on the general evolution of their profiles, the sublimation history of the tips, and the occurrence of grooves, striations, and surface markings. Author (TAB)

N68-36516 National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL STUDY OF THE ABLATION OF GRAPHITE IN THE STAGNATION REGION
Yasuhiko Aihara, Shigeaki Nomura, and Yasuo Watanabe 1968 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-149) CFSTI: $3.00

Experimentally investigated is the aerodynamic heating accompanied with surface combustion in the merged stagnation region of blunt bodies made of graphite. At lower surface temperatures, the oxidation of graphite is reaction-rate controlled. As the surface temperature rises, the process turns out to be diffusion-rate controlled and the oxidation is limited by the rate at which oxygen diffuses to the surface. The variation of the heat transfer rate with surface temperature is found to be in agreement with Scala's theory qualitatively in the reaction-rate controlled regime, and quantatively in the diffusion-rate controlled regime, respectively. Optical measurements of the environment are made for the sake of further investigation on the flow field and the surface reaction such as the effect of low Reynolds number, the effective surface area, and the diffusion of products of combustion. By examining the present results and the data on the rate of mass loss of graphite obtained so far, it is verified that the graphite as an ablator has the characteristics predicted by Scala in terms of the effective heat of ablation. Author

N68-36518 National Aerospace Lab., Tokyo (Japan).
MINIMUM HEAT TRANSFER BODY AT HYPERSONIC SPEEDS
Yasuhiko Aihara 1968 12 p refs In JAPANESE; ENGLISH summary
(NAL-TR-151) CFSTI: $3.00

Analytically investigated in this report is the minimum heat transfer body of revolution at hypersonic speeds. The method of analysis is essentially the same as that developed for the minimum drag body[2]. Variational calculus is applied to the total heat transfer rate which is obtained from the integral of L. Lee's result[1] for laminar convective heating through the compressible boundary layer in equilibrium or in frozen state. The following results are obtained: (1) the minimum heat transfer body with a given large fineness ratio has a geometry composed of a flat nose and a curved side wall which varies approximately as the 3/5 ~ 1/2 power of the axial distance, and (2) the minimum heat transfer body with a given volume and a given base diameter is a cone with a semi-vertex angle of less than 30°, provided that the relation between the volume and the base diameter is compatible with it. Author

N68-36543# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
ON THE OPERATION OF PULSE-JETS [UEBER DIE WIRKUNGSWEISE VON SCHMIDT-ROHREN]
G. Zhuber-Okrog Aug. 1968 38 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-49; DVL-787) CFSTI: HC $3.00/MF $0.65

The possible energy output of pulsejets is determined from a thermodynamic investigation of the Lenoir cycle. A geodynamic investigation by means of a wave diagram shows that restrictions at the open end have to be avoided, and that a certain pressure loss in the valves or back pressure which results in inflow at the open end, is necessary. The mechanism of self-ignition, which is initiated by the action of a pressure wave, also requires that the flames be held in wakes during the intake phase of the combustion process. Author

N68-36544* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
HEAT SHIELD INSTRUMENTATION: DEVELOPMENT AND EVALUATION
Earl W. Hicks, Jr. Oct. 1965 17 p refs Presented at the 20th Ann. ISA Instrumentation-Automation Conf. and Exhibit, Los Angeles
(NASA-TM-X-60472) CFSTI: $3.00 CSCL 20M

Methods and techniques for monitoring critical heat shield parameters during spacecraft reentry have been developed and evaluated. The required instrumentation sensors for measurement of pressure, temperature distribution, incident heat flux, char, and ablation are discussed in detail. The calibration and data analyses, human and automatic, applied to the various sensors during simulated reentry evaluation are presented. Author

N68-36558# Naval Research Lab., Washington, D. C.
THE PRODUCTION OF TEMPERATURES BELOW 1°K BY THE ADIABATIC DEMAGNETIZATION OF 50% $Ce(PO_3)_3$ $Ba(PO_3)_2$ GLASS Final Report
Edwin Lewis Althouse 15 Jul. 1968 47 p refs
(NRL-6711; AD-673525)

It was the object of the investigation to determine whether cerium metaphosphate glass (specifically 50% by weight Ce(PO3)3-Ba(PO3)2) is a suitable coolant material for adiabatic demagnetization experiments. Cerium glass is not susceptible to dehydration and attack by glycerine (used for thermal contact) as are many of the hydrated salts. In addition, the concentration of magnetic atoms can be varied over a wide range by diluting the magnetic glass Ce(PO3)3 with the nonmagnetic glass Ba(PO3)2. The principal results of this investigation are: (a) the 50% Ce(PO3)3-Ba(PO3)2 glass was successfully cooled many times by adiabatic demagnetization, and magnetic temperatures as low as 0.0069K were reached, (b) using a cerium magnesium nitrate paramagnetic salt as a thermometer, absolute temperatures as low as 0.02K were observed, and (c) within experimental error, the measured Curie constant for the cerium glass (density 3.57) agrees with that calculated from the Brillouin function for $J = 1/2$ and $1.97 < \text{or} = g < \text{or} = 2.00$. Author (TAB)

N68-36590 Cornell Univ., Ithaca, N. Y.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE STABILITY OF THE LAMINAR NATURAL CONVECTION BOUNDARY LAYER OVER A VERTICLE UNIFORM FLUX PLATE
Cyrus Philipp Knowles (Ph.D. Thesis) 1967 232 p
Available from Univ. Microfilms: HC $10.60/Microfilm $3.00
Order No. 67-17242

An investigation was performed using a low viscosity silicone fluid with a Prandtl number of 7.7. Controlled disturbances were introduced in the uniform flux boundary layer and the resulting disturbances were observed by means of a interferometer and a hot wire anemometer. Points of neutral stability were obtained which show that the temperature coupling in the theoretical equations is important and cannot be neglected. In addition, experimental

disturbance temperature distributions were obtained in the region where the flow is neutrally stable. The theoretical results were compared with the experimental results obtained in silicone fluid and with earlier results obtained in nitrogen. Dissert. Abstr.

N68-36648# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REFINEMENT OF THE EQUATION FOR DETERMINING THE CALCULATED TEMPERATURE DIFFERENCE IN CONVECTIVE BUNDLES WITH GAS RADIATION [UTOCHENIE URAVNENIYA DLYA OPREDELENIYA RACHETNIO RAZNOSTI TEMPERATUR V KONVEKTIVNYKH PUCHKAKH PRI NALICHII GAZOVOGO IZLUCHENIYA]

B. D. Doinikov 11 Sep. 1967 11 p refs Transl. into ENGLISH from Tr. Kuibyshevsk. Aviats. Inst. (USSR), no. 15, 1963 p 177–184

(FTD-HT-23-800-67; AD-673754)

For calculation of the mean temperature difference in convective bundles with gas radiation, use is made of an equation containing the temperatures of the gases before and after the convective bundle, and the saturation temperature at a given vapor pressure. This equation is approximate, since its degree of accuracy decreases with an increase in gas radiation. The present article is an attempt to demonstrate mathematically that introduction of a correction factor can increase the accuracy of the calculation. TAB

N68-36723# National Bureau of Standards, Boulder, Colo. Inst. for Materials Research.

THE THERMAL CONDUCTIVITY OF HELIUM GAS AT MODERATE PRESSURES

Hans M. Roder [1967] 10 p refs Presented at the Thermodyn. Symp., Heidelberg, West Ger., Sep. 1967 Sponsored by Intern. Union of Pure and Appl. Chem.

(R-450)

The apparatus used is a doubly-guarded flat plate calorimeter in which the cell constant is determined by a capacitance method. Experimental values of the thermal conductivity of helium gas are presented for 15 isotherms between 20° and 282°K at pressures from 1 to 30 atoms atmospheres, except for the 50°K isotherm which extends to 50 atmospheres. The highest density is, thus, just under the critical density. The results are analyzed in terms of their density and temperature dependence. Author

N68-36856# General Electric Co., Schenectady, N. Y. Research and Development Center.

HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS Quarterly Report, Oct.–Dec. 1967

F. W. Staub, G. Walmet, and R. O. Niemi [1968] 42 p refs

(Contract AT(30-1)-3679)

(NYO-3679-3; EURAEC-1977; QR-3) CFSTI: HC $3.00/MF $0.65

The analytical effort to derive general equations which accurately predict the void fraction, pressure drop, and heat transfer coefficients in two phase flow with subcooled boiling for various fluids over a wide range of operating conditions is described. Single phase tests at low heat flux were made to serve as a calibration for the measurements and a standard for subsequent comparison with two phase data. Temperature and velocity profiles were correlated. Needed modifications in the insulation in back of the heated section and in the heater support of the test loop were completed. Excitation voltage correction for the heated wall thermocouples were calibrated and it was shown that the conduction error correction for the thermocouple traversing probes is necessary. The effect of undeveloped temperature profiles on the prediction of net void inception is given. NSA

N68-36858# Atomic Energy Commission Research Establishment, Riso (Denmark).

PILOT PLANT VITRIFICATION OF SIMULATED RADIOACTIVE WASTE WITH HEAT PRODUCED BY SENDING ALTERNATING CURRENT THROUGH THE GLASS

Knud Brodersen and Ib Larsen May 1967 47 p refs

(RISO-150)

The principle of heat production by sending alternating current through molten glass is demonstrated in the vitrification of a simulated medium-active waste. Two different pilot plant procedures are tried out. The first is a discontinuous method. The melting takes place in a stainless steel cylinder, which is then used as a permanent storage container. The second method is continuous. The melting takes place in a permanent ceramic chamber encased in a metallic container to ensure air tightness and mechanical strength. The glass is removed continuously through an overflow system and collected in cylinders of ordinary steel. Corrosion of the stainless steel electrodes is no problem, but the corrosion of the ceramic material is somewhat too serious for practical long term use at the present state of the development. NSA

N68-36861*# Factory Mutual Research Corp., Norwood, Mass.

THE FLAMMABILITY OF ELECTRONIC COMPONENTS IN SPACECRAFT ENVIRONMENTS Final Report, 15 Mar.–15 Oct. 1968

Sami Atallah, Ulrich Bonne, and John N. de Ris Oct. 1968 77 p refs

(Contract NAS12-623)

(NASA-CR-86106) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A theoretical model was presented to describe combustion in a zero gravitational field. The differential equations describing energy and mass conservation of such a system were solved by assuming: very fast reaction rates; stoichiometric combustion at the reaction zone; radiative heat losses proportional to the rate of heat release by combustion; and flat fuel surface. Expressions were derived for the burning rate of the fuel, the flame temperature and position and other combustion parameters. A criterion for the flammability of a fuel in a zero g-field was also derived. An upper limit for flame extinguishment time was found by calculating the time necessary for a laminar diffusion flame to cool below the ignition temperature by radiation only. Equations predicting the temperature and pressure rise due to a fast developing fire in an enclosure were derived. Several models for the burning of solid materials were postulated and used to predict temperature and pressure variation with time. The results were compared with experimental data and with the Apollo accident pressure record. Both sources indicate that a burning model leading to an exponential increase of burning rate with time is the most appropriate. Author

N68-36869*# Franklin Inst., Philadelphia, Pa.

INVESTIGATION OF NEW METHODS FOR INCREASING THERMAL CONTACT CONDUCTANCE IN A VACUUM Final Report

S. P. Carfagno Mar. 1968 68 p refs

(Contract NAS8-21237)

(NASA-CR-98014; F-C2076) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The feasibility of two ideas for increasing thermal contact conductance was investigated. One idea was to flatten the tops of asperities on metal surfaces by passing a current pulse across the interface of a joint, while maintaining relative motion between the mating surfaces. The other idea was to overcome the restrictions of surface waviness by making one of the joint surfaces pliable; this took the form of a thin foil backed by a layer of paste. Both methods were investigated initially by using electrical contact conductance measurements to indicate the quality of contact, but study of the pliable surface technique also included measurements of thermal contact conductance in a vacuum environment. The

experimental findings did not support the feasibility of either idea. A brief review of relevant topics and recommendations for further study are given. In particular, an idea for bonding joints with a metal or alloy capable of pressure-induced phase transformation is described. Author

N68-36878# Oak Ridge National Lab., Tenn.
REVIEW AND ANALYSIS OF PHASE BEHAVIOR AND THERMODYNAMIC PROPERTIES OF THE PLUTONIUM-NITROGEN SYSTEM
K. E. Spear and J. M. Leitnaker Mar. 1968 24 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2108) CFSTI: HC $3.00/MF $0.65

The phase behavior and thermodyamic properties of the plutonium-nitrogen system are reviewed and analysed. The section on phase behavior includes the subjects: intermediate phases, composition limits and lattice parameters, phase transitions, melting behavior, and vaporization behavior. Ternary or more complex systems involving plutonium and nitrogen are not considered in this analysis. In the section on the thermodynamic properties of plutonium nitride, it is shown that with the use of reasonable values estimated for the entropy and high-temperature heat capacity of PuN, all existing experimental data can be readily explained and combined into a consistent set of thermodynamic values for the mononitride. Author (NSA)

N68-36930*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.
DESCRIPTION AND USER'S MANUAL FOR A PROGRAM TO ANALYZE LOADS AND HEATING ON BODIES SUBJECT TO ROCKET EXHAUST PLUME IMPINGEMENT
H. W. Butler Feb. 1968 118 p refs
(Contract NAS8-21150)
(NASA-CR-98004; HREC/1150-2; LMSC/HREC-A791231) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The computer program, which is described, was specifically designed to calculate heating rates, surface pressures, forces and moments for a body subjected to rocket exhaust impingement; however, it is capable of analyzing impingement due to any supersonic flow field. Pressures are calculated in continuum flow using modified Newtonian theory, in free molecular flow using kinetic theory, and in transitional flow using empirical relationships. Convective heating rates in the continuum or transitional flow regimes are calculated along streamlines using a divergence technique. Heating values for continuum laminar, continuum turbulent, and transitional flow are obtained at the stagnation point and then distributed over the body according to the streamline divergence. Momentum Reynolds number transition criteria are output in order for the user to choose the most applicable of the three heat rates that are provided. Free molecular heating rates are also calculated at each elemental area from an energy balance type equation and the decision of which flow regime to consider is simplified by a printout of the applicable flow regime. Author

N68-36985# Technische Hochschule Hannover (West Germany).
GAS DYNAMIC PHENOMENA DURING THE DARK PHASE OF WIRE EXPLOSIONS AND THEIR IMPORTANCE FOR REIGNITION [UEBER DIE GASDYNAMISCHEN VORGAENGE WAEHREND DER DUNKELPAUSE VON DRAHTEXPLOSIONEN UND IHRE BEDEUTUNG FUER DIE WIEDERZUENDUNG]
Wilhelm Tiemann (Ph.D. Thesis) 1968 92 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Schlieren photographs of electrical wire explosions with silent phases show that reignition charges depend on the geometric dimensions of the ionized metal vapor that expands during the silent period. Reignition takes place before the shock wave front reflects from the plasma cylinder axis or after shock front reflection from the plasma axis. Transl. by G.G.

N68-37012# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
HEAT EXCHANGE AND PRESSURE DROP OF HERRING-BONE FIN FACES. EXPERIMENTAL CELL RESULTS AT CONSTANT WALL TEMPERATURE [ECHANGE DE CHALEUR ET PERTE DE CHARGE DE SURFACES A AILETTES EN CHEVRONS. RESULTATS EXPERIMENTAUX EN CELLULE A TEMPERATURE DE PAROI CONSTANTE]
Jan. 1968 64 p refs In FRENCH; ENGLISH summary
(CEA-R-3425)

The increase in the specific power of nuclear reactors of the gas-graphite type has necessitated the use of high performance exchange surfaces for canning the fuel (natural uranium). Experiments were carried out on cans fitted with herring-bone fins, at constant wall temperature; a flow of water at 100°C passes inside the can which is cooled externally by a flow of CO_2 at 15 bars pressure. The experimental set-up makes it possible to compare the aerothermal performances of the different cans with an accuracy of 5 per cent. The results obtained are presented in the form of a friction coefficient f_0 and mean Margoulis number M_0, as a function of the Reynolds number Re_0, this latter varying from 3×10^5 to 9×10^5. Author (NSA)

N68-37024# Union Carbide Corp., Indianapolis, Ind. Linde Div.
RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY Quarterly Progress Report, Mar.–May 1968
May 1968 72 p refs
(Contract AT(30-1)-3632)
(ALO-3632-29) CFSTI: HC $3.00/MF $0.65

Results of long term thermal conductivity tests are presented for insulation systems of nickel foil spaced by quartz paper, aluminum foil spaced by opacified paper, glass paper opacified with aluminum flakes, and quartz paper opacified with copper flakes. Results of an error analysis on all cylindrical thermal conductivity tests conducted to date are presented. Thermal conductivity data which have been updated to reflect the error analysis results are presented. Thermal conductivity data as a function of temperature and mechanical load are presented for the insulation systems. Empirical equations describing the above data are presented. Equations relating to the opacified paper include a preliminary assessment of the scattering properties of the materials. Results of an analytical study aimed at determining the effect of a penetration through an insulation panel are presented. Effect of the penetration (typically a thermoelectric element) on both total heat transfer, as well as on heat transfer through the individual system elements (i.e., insulation and penetration), is considered. NSA

N68-37032# European Space Technology Center, Noordwijk (Netherlands).
A THERMAL MATHEMATICAL MODEL OF A SUPPORT USED IN THE THERMAL VACUUM TESTING OF SPACECRAFT
J. Doenecke Paris ESRO Jan. 1968 31 p refs
(ESRO-TN-16(ESTEC)) CFSTI: HC $3.00/MF $0.65

The method used to determine the thermal mathematical model for the supporting device (known as the 'sting') which connects a spacecraft under test to the motion gear of the vacuum chamber, is described. The sting, which is 57 cm long and weighs approximately 44 kg, was divided into 11 isothermal nodes, and an initial thermal mathematical model was calculated. The sting flange to which the satellite is attached was heated, there being four separate heating periods, and the temperatures of the nodes were measured continuously for 5 3/4 hours. For this test there was no advantage in cooling the chamber walls with liquid nitrogen. In the light of the test results, adjustments were made to the initial model, and the temperature-time curves were recalculated using the refined model. The results obtained were in excellent agreement with the measured values Author (ESRO)

N68-37078# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

THERMONUCLEAR PRESSURE DIFFERENCE FOR HELIUM 4 [EFFETS THERMONUCLEAIRES DANS L'HELIUM 4]

Gérard Der Nigohossian and Pierre M. Roubeau Mar. 1968 125 p In FRENCH; ENGLISH summary

(CEA-R-3485) CFSTI: HC$3.00/MF$0.65

When a mass of gas is contained in a tube, the ends of which are at different temperatures, there is a pressure difference, called thermomolecular pressure difference, between the hot and cold ends of the tube. When the mean free path of the gas molecule is comparable with the diameter of the tube, the Weber-Schmidt equation is generally applicable. This equation has been solved for ^4He by use of the IBM 360/75 and IBM 7094 computers for various values of diameters, T_C, T_F. Results are shown in tables and curves. ESRO

N68-37110*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MEASUREMENT OF THERMAL CONDUCTANCE OF MULTILAYER AND OTHER INSULATION MATERIALS Final Report

Erwin Fried and Gerald Hieser 5 Aug. 1968 15 p refs Suppl. (Contract NAS9-3685)

(NASA-CR-92329; Rept.-67SD4388A) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Thermal conductance measurements were obtained for additional spacesuit thermal insulation candidates under varying degrees of compression. Boundary temperatures varied from −320 to +285°F with the body side temperature held at about 70°F in all cases. The majority of test points at test conditions of interest were obtained for a laminated aluminized 1/2-mil Kapton–Beta–glass marquisette insulation. Tests of a gold on mylar layup were also made for a total of 21 valid steady state conductance tests. A schematic of the various layups tested is shown. The test results are tabulated in a manner to permit comparison of data. These data are also shown graphically. Author

N68-37116# European Space Technology Center, Noordwijk (Netherlands).

THERMAL SCALE MODELLING WITHOUT THERMAL SIMILITUDE

J. Doenecke Paris ESRO Nov. 1967 20 p refs

(ESRO-TN-19(ESTEC)) CFSTI: HC$3.00/MF$0.65

It is shown that the thermal mathematical model of a spacecraft may be determined by measurements made on a model scaled and tested without the laws of similitude. For example the skin may be anisotropically scaled but the materials and thermal contact coefficients may be preserved. The resulting thermal analysis is made slightly more complicated, but either the construction or the testing of the model is simplified. Author (ESRO)

N68-37186*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

RADIATIVE TRANSFER BY DOUBLING VERY THIN LAYERS

James E. Hansen [1968] 24 p refs

(NASA-TM-X-61296) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A doubling principle first used by van de Hulst was developed to provide rapid and accurate results for the problem of diffuse reflection from a plane parallel atmosphere. The method eliminates the need of numerically solving an equation of radiative transfer by beginning with a layer of such small optical thickness (τ-2 −2β) that the initial scattering and transmission functions are given by the phase function. An application is made to spectral scattering by clouds in the near-infrared where the phase function is strongly peaked in the foreward direction. Author

N68-37205 Washington Univ., St. Louis, Mo.

STATISTICAL MECHANICS OF THERMALLY DRIVEN SYSTEMS

William Cobbey Mitchell (Ph.D. Thesis) 1967 102 p

Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17193

A theory is developed which stands in the same relation to thermohydrodynamics as Gibbs' statistical mechanics stands to equilibrium thermodynamics. In each case, the basic problem is to construct a microscopic ensemble from macroscopic information. The new theory offers a general procedure for constructing ensembles from time-dependent macroscopic source terms, such as those appearing in the conservation laws of hydrodynamics. Experimentally, the imposition of such macroscopic constraints imposes certain restrictions on the possible microstates; correspondingly, in the theory, *information* about macroscopic conditions must be used to locate the manifold of microstates compatible with that information. The approach is based on the concept of information entropy as a measure of the degree of restriction imposed on microstates by macroscopic information. Dissert. Abstr.

N68-37206 California Univ., San Diego.

NUCLEAR COOLING AND He^3 BELOW 10M°K

Edwin Boyd Osgood (Ph.D. Thesis) 1967 81 p

Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-768

An apparatus is described that uses the technique of adiabatic demagnetization of copper nuclei. Temperatures in the coolant of 0.85 m°K were achieved. Temperatures were maintained below 1.0 m°K for more than seven hours. The apparatus was used to cool He^3 to 4 m°K. Measurements of specific heat, susceptibility and thermal boundary impedance were made at 0.4 and 25.4 atmospheres in the temperature range from 4 m°K to 10 m°K. The data is not sufficiently accurate, nor taken over a sufficiently broad range of temperatures to detect the deviation from a strictly linear temperature dependence of the specific heat observed by the Urbana group. The susceptibility is constant within ±5%. Thermal conduction between He^3 and insulated copper wires is found to be proportional to the difference in the fifth power of the temperature. No evidence was observed in any of the data for a superfluid phase transition in He^3 above 4 m°K. Dissert. Abstr.

N68-37289# New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.

GENERAL CONSIDERATIONS CONCERNING ATMOSPHERIC AEROSOL MONITORING WITH THE HYDROGEN FLAME IONIZATION DETECTOR

R. Wayne Ohline, Edwin Thall, and Ping Hwat Oey [1968] 22 p refs

The primary non-organic constituent of the atmosphere giving a response with the hydrogen flame ionization detector is sodium. Consequently, it appears that continuous, non-attended operation of the detector for organic aerosol monitoring can be achieved if ion pulses arising from sodium-containing particles can be subtracted from the total charge delivered in the pulse mode. In order to understand the response characteristics for the detector to sodium salts, the rate of ion formation has been studied, and first-order rate constants for the ionization of sodium in five small hydrogen diffusion flames determined. Rate data obtained from these studies indicate that the detector can detect particles of sodium chloride 0.1 micron in diameter. Author

N68-37380*# Atlantic Research Corp., Alexandria, Va.

SURVEY OF VAPOR PHASE CHEMICAL AGENTS FOR COMBUSTION SUPPRESSION

E. T. McHale Aug. 1968 26 p refs (Contract NAS2-4988)

(NASA-CR-73263) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A literature survey was made in the areas of combustion suppression. For the most part, the cited reviews emphasized laboratory scale research. The scope of the reviews is limited to chemical suppressants, both homogeneous and heterogeneous, acting mainly on hydrocarbon or hydrogen flames with air or oxygen. Inhibition by purely physical action such as smothering or cooling it is not dealt with as such. Studies of both premixed and diffusion flames are included. The types of measurements used to evaluate inhibitor effectiveness and possible chemical reaction mechanisms by which they act are considered. A discussion is included on requirements of suppressants for flight vehicles and application of principles to practical fire control. Author

N68-37406*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AERODYNAMIC FACILITIES
In its Space Programs Sum. no. 37-51, vol. 3 30 Jun. 1968 p 95-96 (See N68-37397 23-11)

Reported is the initiation of a study designed to determine the applicability of available theories of laminar convective heat transfer in planetary gases. Studies are being performed on three 60-degree half angle blunted cones in the 43-in. hypersonic shock tunnel and the 12-in. free piston shock tube. Measurement of the pressure distributions were completed. These measurements were carried out entirely in the 43-in. hypersonic shock tunnel. The pressure study consisted of measurements at 45-degree increments of roll angle for the following angles of attack: α = 0, 5, 10, 15, 20, and 30 degrees. Samples of data obtained for a body at α = 0 degrees are shown, and for a body pitched to α = 15 degrees. Heat transfer distributions are being measured and will be compared to values predicted by using measured pressure distributions as input to a convective heat transfer computer program. S.C.W.

N68-37408*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Space Programs Sum. no. 37-51, vol. 3 30 Jun. 1968 p 101-108 refs (See N68-37397 23-11)

Solid propellant engineering research is reported which focuses on studies of (1) molecular momentum transfer from regressing solid propellant surfaces, and (2) acoustic losses of a 1.5-inch diameter T-burner. S.C.W.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-36816* California Univ., Berkeley. Space Sciences Lab.
RESEARCH AND DEVELOPMENT FOR DOMESTIC IMPERATIVES: A DESIGN FOR DECISION
Scott J. Mc Crea May 1968 80 p refs *Its* Internal Working Paper No. 85
(Grant NSG-243)
(NASA-CR-97184) CSCL 05A

Research and development management concepts, especially decision making, are discussed in applications to the solution of complex social problems. A literature survey revealed a deficiency in decision making approaches for the solution of social problems. One proposal providing a "systems" strategy, called sequential experimentalism, is presented as a decision making concept based on a continual learning process as attempts are made at alleviating social problems via research and development. The question of identification and definition of the decision maker in the social R & D domain is also explored. D.H.B.

N68-36643*# Oklahoma State Univ., Stillwater. Coll. of Engineering.
A PILOT PROGRAM FOR SELECTING, EDITING, AND DISSEMINATING ENGINEERING AND SCIENTIFIC EDUCATIONAL SUBJECT MATTER FROM NASA TECHNICAL REPORTS Quarterly Report, 1 Jun.-31 Aug. 1968
31 Aug. 1968 69 p refs (Contract NSR-37-002-045)
(NASA-CR-97220; ER-68-I-4) CFSTI: HC $3.00/MF $0.65 CSCL 05B

Statistical data are presented on the 18 educational monographs and 21 visual briefs which are being disseminated to universities and industries for evaluation. Some 1924 instructor copies and 5629 student copies of educational monographs were mailed. A total of 8% (university plus industry) of the instructor copies were evaluated and returned. Of these, 91% found the information favorable. Two hundred thirty-four visual briefs were distributed and 47% of the requestees returned the evaluation forms. Completed abstracts of the educational monographs, individual dissemination statistics, lists of university personnel who received monographs for review, and reviewers' comments on brief and monographs are included. B.P.

N68-36682*# Midwest Research Inst., Kansas City, Mo.
OPERATION OF A NASA TECHNOLOGY UTILIZATION REGIONAL DISSEMINATION CENTER: REGIONAL UTILIZATION OF NASA GENERATED SPACE TECHNOLOGY, VOLUME 1 Final Report, 5 Nov. 1961-15 Oct. 1968
Paul C. Constant, Jr. 15 Oct. 1968 155 p refs
(Contracts NASr-63(03); NASr-63(12); MRI Proj. 2563-M; MRI Proj. 3064-E)
(NASA-CR-97193) CFSTI: HC $3.00/MF $0.65 CSCL 05B

An overview is presented on the success and limitations of the various approaches taken to effect technology transfer, and on the activities of a regional dissemination center such as ASTRA (applied space technology—regional advancement). Starting with the initial efforts to identify innovations resulting from NASA's research and development work, the program history is traced to show the steps taken to achieve proven feasibility of regional dissemination, the operation of a regional dissemination center which was funded 100% by NASA, the shift to a self-supporting basis, and the cost sharing of companies with eventual cost responsibility to be assumed by each company. The basic concepts of ASTRA are cited as (1) the intellectual capabilities of those directly involved in technology transfer; (2) the attitudes of the technical man, the manager, and the ultimate recipient of the transfer; (3) the environments in which transfer activities are undertaken; and (4) the tools available to the transfer agent or technologist. Organizational and operational procedures are outlined. Summary data are included on the 125 technology transfers reported, and cost equations for search services are given. M.G.J.

N68-36683*# Midwest Research Inst., Kansas City, Mo.
OPERATION OF A NASA TECHNOLOGY UTILIZATION REGIONAL DISSEMINATION CENTER. VOLUME 2: REGIONAL UTILIZATION OF NASA GENERATED SPACE TECHNOLOGY Final Report
Lawrence Rosine 5 Aug. 1968 104 p
(Contracts NASr-63(03); NASr-63(12); MRI Proj. 2563-M; Proj. 3064-E)
(NASA-CR-97258) CFSTI: HC $3.00/MF $0.65 CSCL 05B

Details are given on the organization, business and operational procedures, and management and technical services of ASTRA (applied space technology—regional advancement), which functions as a regional dissemination center (RDC). The steps necessary for setting up an operational RDC are outlined, and examples of the forms used in the office procedures and of public relations materials are

included. As the primary purpose of the RDC is technology transfer, two basic forms of transfer are briefly reviewed: the retrospective search which is concerned primarily with historical information or documents previously published, and the current awareness search which reviews all new incoming information on a periodic basis for relevance to the problem. The need for analyzing the market in order to pace the growth of the RDC to the growth of the industrial environment is stressed. Consideration is also given to operating an RDC under a variety of conditions, such as an academic environment, industrial support, or autonomously. M.G.J.

N68-36920# European Space Technology Center, Noordwijk (Netherlands).
SYSTEM MANAGEMENT: OPTIMIZATION OF A SATELLITE PROJECT
J. Schatz Paris ESRO Apr. 1968 20 p refs
(ESRO-TM-132(ESTEC)) CFSTI: HC $3.00/MF $0.65

The economics of a project can be improved by incorporating a project optimization group in the organization of the project program. Such a group should consist of specialists in the technical, financial, planning and organizational fields. It assesses the progress made on the project between the management and the specialist teams, evaluates any anomalies in the program, submits proposals for optimization to the project management and, if they are rejected, refers them to the executive management. Author (ESRO)

N68-37058# Weapons Research Establishment, Salisbury (Australia).
WEAPONS RESEARCH ESTABLISHMENT ANNUAL REPORT 1966–1967
[1968] 58 p
CFSTI: HC $3.00/MF $0.65

The research facilities at the Weapons Research Establishment in Australia are described. Research and project activities on the space and weapons field are illustrated with a note on the electronic equipment and techniques. Special attention is given to flight dynamics of bombs, rocket propulsion tests and upper atmosphere research. ESRO

N68-37216*# Little (Arthur D.), Inc., Cambridge, Mass.
SPACE TECHNOLOGY TRANSFER AND DEVELOPING NATIONS
Peter E. Glaser, Robert M. Jolkovski, Claudio Margueron, and Walter M. Noel Washington NASA Oct. 1968 158 p refs
(Contract NASw-1649)
(NASA-CR-1222) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The potential for transferring space technology advances to aid developing nations was assessed using Brazil as a model. The NASA technical information file was searched to retrieve document abstracts relevant to Brazilian developmental needs in agriculture, public health, exploration and utilization of natural resources, industrialization, housing, education and training, communications, and transportation. More than 40 matches of need with technology were obtained. Included in the findings are: (1) Technology oriented searches (refrigeration and electric power, for example) provided a broader range of relevant abstracts than problem oriented searches for example, forest clearing and road construction. (2) Because all abstracts are in English, transfer to technology to developing nations would be impeded. (3) Abstracts containing information on principles, development status, application results, costs, and feasibility had the highest potential for matching. (4) Information search printouts in the form of document titles and key words only are inadequate for technology transfer matching. E.C.

N68-37288*# California Univ., Berkeley. Space Sciences Lab.
THE "DISADVANTAGED": UNEMPLOYABLE OR JUST UNEMPLOYED?. A REPORT ON TRAINING FOR UNIVERSITY EMPLOYMENT
Stephen Zwerling Sep. 1968 35 p refs
(Grant NsG-243)
(NASA-CR-97374) CFSTI: HC $3.00/MF $0.65 CSCL 05C

In an attempt to analyze the role of institutions of higher education in solving some of the socio-economic problems of the community, the university is viewed as an employer and a trainer of people through a request from the Space Sciences Laboratory for an evaluation of a training program for four disadvantaged citizens. The training is conducted under the auspices of New Careers. New Careers is a program authorizing grants to or contracts with state or local agencies to subsidize work training programs for unemployed or low income adults and which seeks to develop definite career ladders with particular emphasis according to the importance of upward mobility. The program is an attempt to provide the poor with new opportunities and it differs from most other poverty programs by requiring an educational component for the trainee. C.L.W.

N68-37379# Congress. House. Committee on Science and Astronautics.
UTILIZATION OF FEDERAL LABORATORIES
Washington GPO 1968 70 p Hearings before Subcomm. on Sci., Res., and Develop., 90th Congr., 2d Sess.
Available from GPO

Shortcomings in the present Federal Laboratory system are pointed out, and a number of recommendations to increase the efficiency and capabilities of Government laboratories are made, these include: (1) Current policy for interagency use of Government laboratories should be restated. (2) Responsibility and guidelines for administration of laboratory utilization policy should be established. (3) Discretionary funds should be available to laboratory directors to use for forward looking research relevant to agency interests and national problems. (4) Laboratory personnel on interagency work should be exempt from agency personnel ceilings. (5) Laboratory direction participation in the formulation of federal laboratory policy should be fostered and the Economy Act of 1932 implemented. (6) An experimental inventory of all federal laboratories, including the Atomic Energy Commission, should be expedited, along with ways of appraising the performance and productivity of laboratories. Immediate attention is recommended for research and development for law enforcement and crime control. B.P.

N68-37382# Congress. House. Committee on Government Operations.
INVESTIGATION OF THE BOEING-TIE CONTRACT, PART 1
Washington GPO 1968 31 p Hearings before Subcomm. on Govt. Operations, 90th Congr., 2d Sess., 15 Jul. 1968
Available from GPO

The text is presented on the hearings pertaining to the NASA contract on employing approximately 300 Boeing personnel at NASA Headquarters to manage the integration of the Apollo program. Questioning centered on the type of contract, the cost, and the implication that the civil service professional staff at NASA Headquarters was unable to provide the program director with the technical assessments necessary to make management decisions. M.G.J.

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